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NATIONAL DAM SAFETY PROGRAM. BROWNS FALLS DAM (INVENTORY NUMBER--ETC(U)
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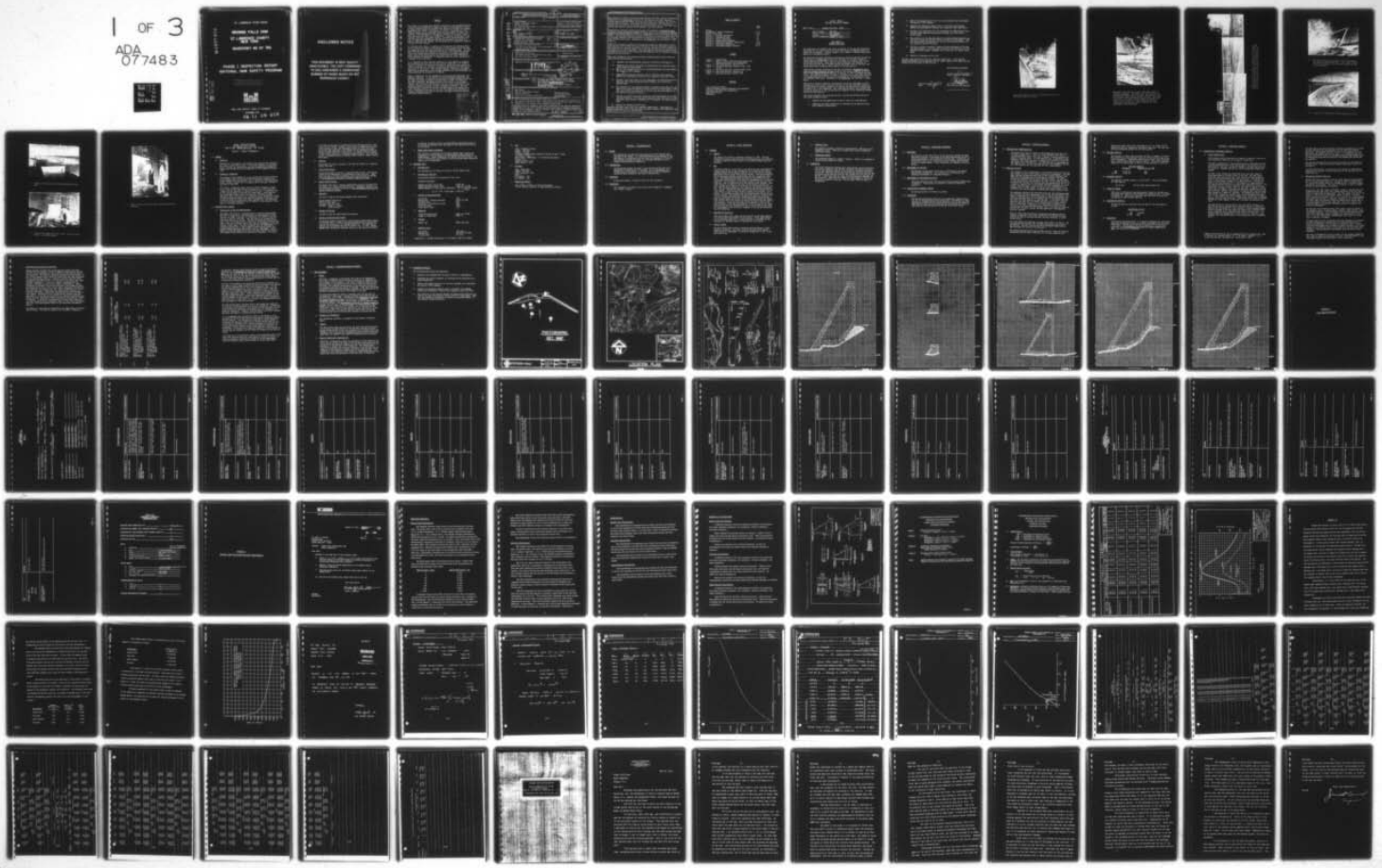

ST. LAWRENCE RIVER BASIN

BROWNS FALLS DAM

ST. LAWRENCE COUNTY
NEW YORK

INVENTORY Nº NY 762

AD A077483

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

CONTRACT NO. DACW-51-79-C0001

NEW YORK DISTRICT CORPS OF ENGINEERS

SEPTEMBER 1979

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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REPORT DOCUMENTATION PAGE

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18. SUPPLEMENTARY NOTES

National Dam Safety Program, Browns Falls Dam (Inventory Number NY 762), St. Lawrence River Basin, [illegible] River, St. Lawrence County, New York. Phase I Inspection Report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety
National Dam Safety Program
Visual Inspection
Hydrology, Structural Stability
Browns Falls Dam
St. Lawrence County
Coffins Mills

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

The examination of documents and visual inspection of the dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. The dam, however, has a number of problem areas which should be investigated further.

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The structural analysis indicates unsatisfactory stability against overturning according to the Guidelines criteria for the cases of the dam subject to forces possible during normal operation (including ice loading), the 1/2 PMF, and the PMF conditions. Under each of these conditions, the resultant of forces acting on the dam is located outside the middle third of the base indicating that tensile stresses would develop in the dam section.

Computations prepared according to the Corp of Engineers' Recommended Guidelines for Safety Inspection of Dams establish the spillway capacity as ~~65 percent~~ 65% of the Probable Maximum Flood and 130% ~~percent~~ of the 1/2 Probable Maximum Flood. The hydrologic/hydraulic analysis indicates the spillway would pass the 1/2 Probable Maximum Flood but would be overtopped by one foot during a Probable Maximum Flood event. According to the Guidelines, the spillway is inadequate.

Additional structural stability investigations should be undertaken to fully evaluate the uplift forces acting at the base of the dam and should extend to the evaluation of physical properties of the dam concrete and the installation of anchor pins in the foundation. The investigation should also evaluate the structural condition of the old dam and the integrity of the connection between the old and new sections.

The visual inspection and screening analysis revealed deficiencies which require the following actions:

1. Complete the aforementioned structural stability investigations.
2. Undertake any repairs necessary as indicated by the detailed structural stability evaluations.
3. Monitor the seepage occurring at the north abutment and investigate the source of this seepage.
4. Complete the necessary remedial work to eliminate this seepage, should the investigation indicate that dangerous conditions exist.
5. Provide a low level drain for the impoundment by rehabilitating the existing drain opening removing the blockage, and installing a control gate.
6. The condition of the concrete beneath the deteriorated shotcrete surface on the south non-overflow section should be investigated. Remedial work should be undertaken to correct any concealed defects in the original concrete structure.
7. Provide a program of periodic inspection and maintenance of the dam and appurtenances, including yearly operation and lubrication of the reservoir drain system. Document this information for future reference.
8. Develop an emergency action plan.

The work described above should be commenced immediately. Investigations should be completed within one year and the needed remedial work should be completed within two years of notification.

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Name of Dam Browns Falls Dam, NY762

State Located New York
County Located St. Lawrence
Stream Oswegatchie
Date of Inspection August 12, 1979

ASSESSMENT OF GENERAL CONDITIONS

The examination of documents and visual inspection of the dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. The dam, however, has a number of problem areas which should be investigated further.

The structural analysis indicates unsatisfactory stability against overturning according to the Guidelines criteria for the cases of the dam subject to forces possible during normal operation (including ice loading), the 1/2 PMF, and the PMF conditions. Under each of these conditions, the resultant of forces acting on the dam is located outside the middle third of the base indicating that tensile stresses would develop in the dam section.

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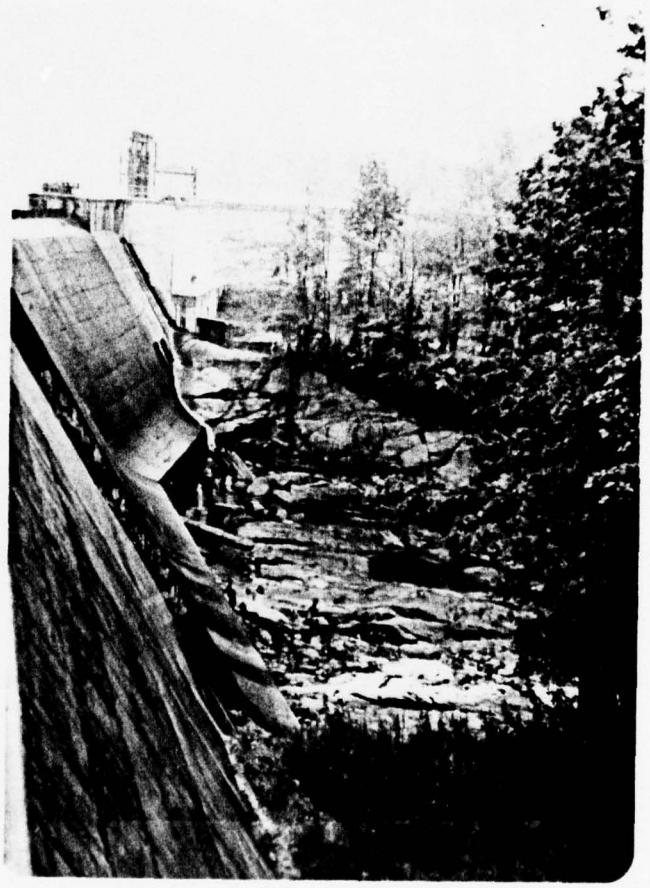
Dale Engineering Company

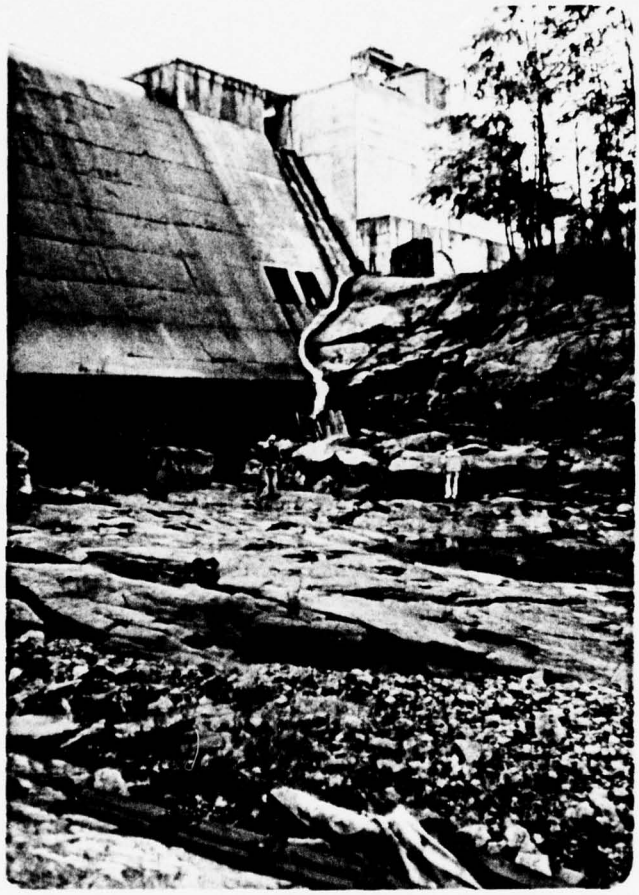
John B. Stetson, President

Approved By: Col. Clark H. Benn
Date: 28 Sept 79

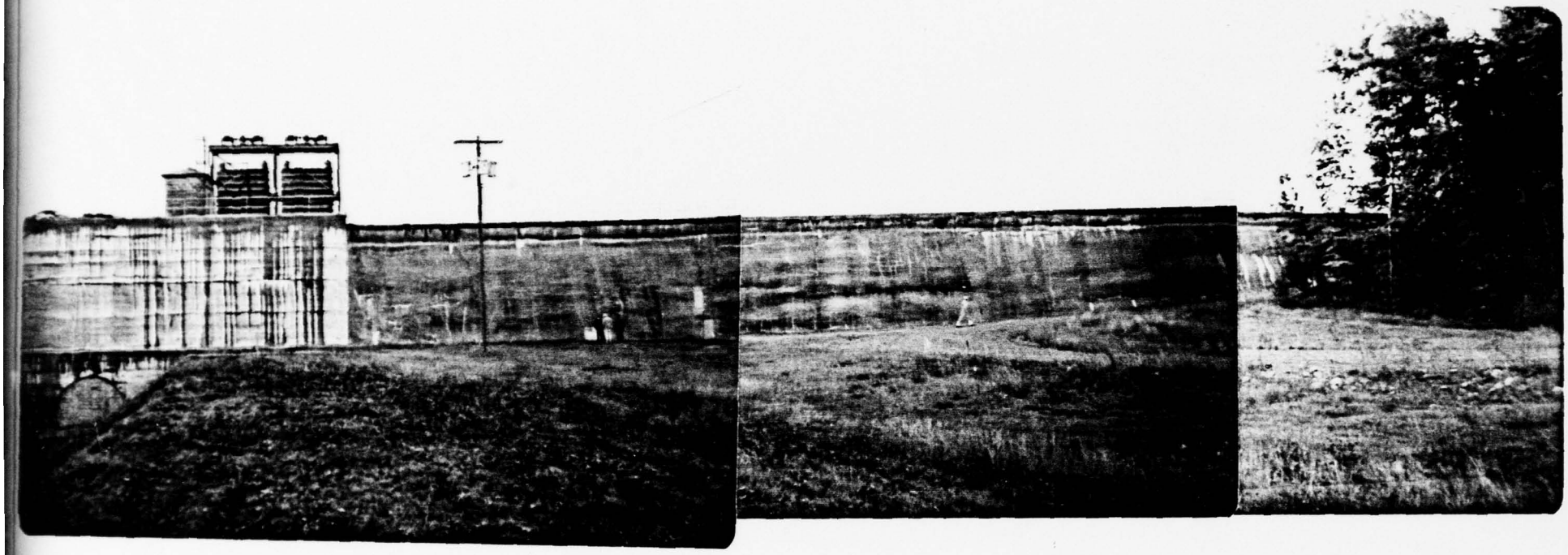
New York District Engineer



Overview of Brown's Fall Dam looking south across the downstream face of the dam.

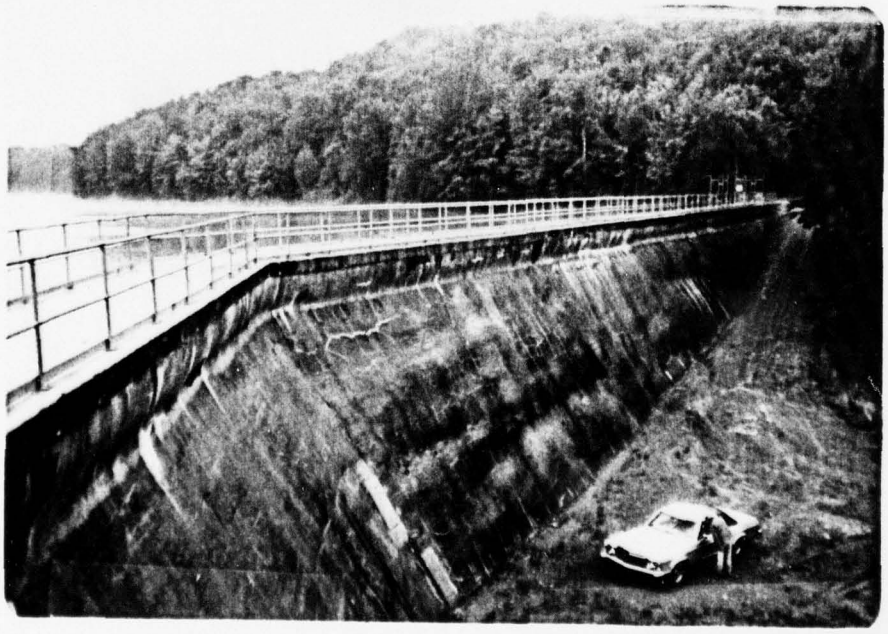


1. Abutment of deep section of dam. The lower outlet is reportedly plugged. The upper level twin outlets are manually controlled atop of the dam. Discharge is coming through a water passage high on the dam. The large structure to the right is the forebay area which discharges into a large 12-13 feet diameter, 600 feet long steel pipeline which supplies the Brown's Fall powerhouse at 260 foot head.

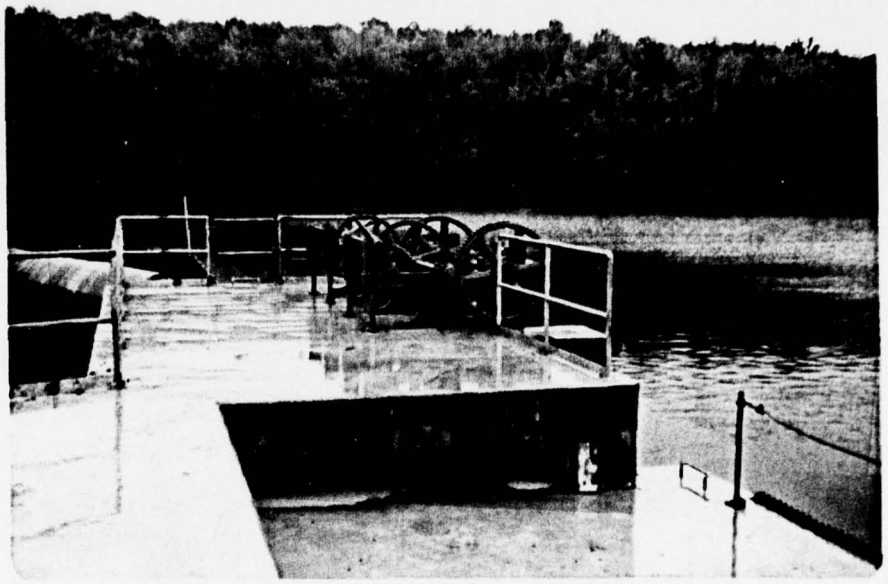


2. South portion of the dam is founded on high ground. Forebay structure shown in left portion of picture. The structure to the right of the forebay has a shotcrete covering which is beginning to deteriorate.

3. The north portion of the dam has a 12 inch concrete overlay on the downstream face. This recent overlay has limited seepage at the base and through the construction joints.

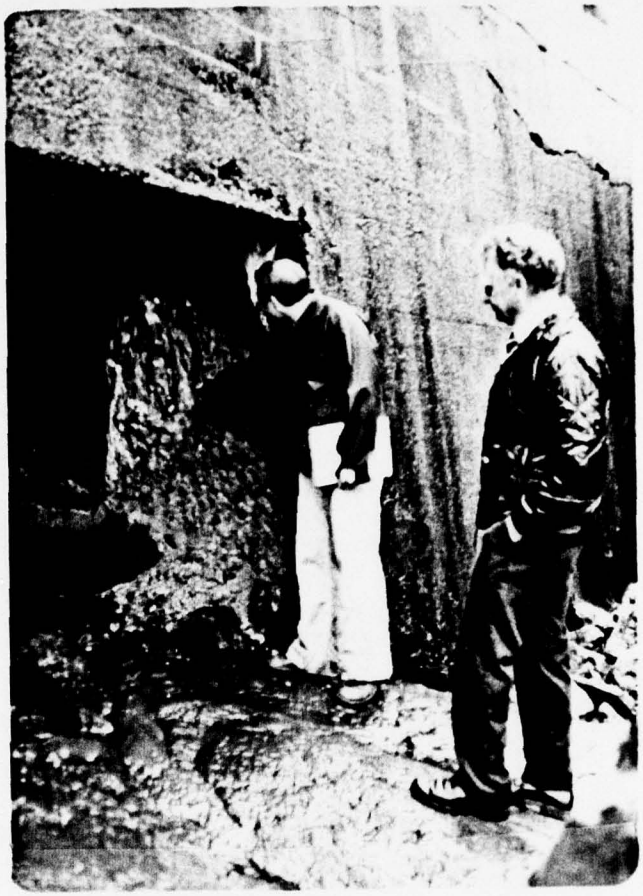


4. Close-up of south section showing shotcrete surface.



5. Close-up of high level twin outlet mechanical equipment.

6. Close-up of plugged low level outlet. Notice surface cracks in spillway section.



7. Detail of dam level outlet wall showing deteriorated concrete.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM - BROWNS FALLS DAM ID# - NY 762

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

Authority for this report is provided by the National Dam Inspection Act, Public Law 92-367 of 1972. It has been prepared in accordance with a contract for professional services between Dale Engineering Company and The New York State Department of Environmental Conservation.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the existing condition of the Browns Falls Dam and appurtenant structures, owned by the Niagara Mohawk Power Corporation, and to determine if the dam constitutes a hazard to human life or property and to transmit findings to the State of New York.

This Phase I inspection report does not relieve an Owner or Operator of a dam of the legal duties, obligations or liabilities associated with the ownership or operation of the dam. In addition, due to the limited scope of services for these Phase I investigations, the investigators had to rely upon the data furnished to them. Therefore, this investigation is limited to visual inspection, review of data prepared by others, and simplified hydrologic, hydraulic and structural stability evaluations where appropriate. The investigators do not assume responsibility for defects or deficiencies in the dam or in the data provided.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

The Browns Falls Dam is a concrete gravity structure approximately 870 feet in length with a maximum height of approximately 70 feet. The main spillway of the dam is located near the center of the dam and has a length of 192 feet. This spillway is at an elevation 5 feet below the top of the dam. The dam is founded entirely on bedrock. Two, 5-1/2 feet wide by 6 feet high sluice gates, located just west of the main spillway, allow flow from the impoundment to be regulated to some extent. Further discharge from the impoundment is regulated through the 12 foot diameter pipeline which serves the Niagara Mohawk Powerhouse downstream from the impoundment. Sluice gates are operated mechanically while the gates controlling flow to the forebay of the pipeline are electrically operated. A 5-1/2 by

5-1/2 foot sluice gate is located within the spillway section to provide low level outlet. However, this outlet is plugged at the inlet of the opening so that the impoundment cannot be fully drawn down. Provisions have been made in the forebay of the powerhouse outlet to accept a second pipeline in the future. The outlet from the forebay to this future pipeline is presently plugged concrete. The receiving stream is composed entirely of bedrock and no signs of recent erosion were noted.

b. Location

The Browns Falls Dam is located in the Town of Clifton, St. Lawrence County, New York.

c. Size Classification

The maximum height of the dam is approximately 70 feet. The storage volume of the impoundment is approximately 3,000 acre feet. Therefore, the dam is in the Intermediate Size Classification as defined by The Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

The Browns Falls Dam is located approximately one mile upstream from the Browns Falls power generating station. Therefore, the dam is in the High Hazard Category as defined by The Recommended Guidelines for Safety Inspection of Dams.

e. Ownership

The dam is owned by the Niagara Mohawk Power Corporation.

Niagara Mohawk Corporation
300 Erie Blvd. West
Syracuse, New York 13202
Engineer - Robert J. Levett
(315) 474-1511

f. Purpose of the Dam

The dam is used for power generating purposes.

g. Design and Construction History

The original Browns Falls Dam was constructed by Benson Mines Company in 1913 and 1914. In 1922, this dam was modified by increasing the size of the structure to its present dimensions. This work was undertaken by the Northern New York Utilities, Inc. In 1977, Niagara Mohawk Power Corporation undertook repairs to the existing structure

by placing a concrete overlay on the northerly non-overflow section of the dam and patchwork was undertaken on the remaining portions of the structure.

h. Normal Operational Procedures

This facility is operated by the Niagara Mohawk Power Corporation. Flashboards on the spillway to provide maximum storage during the summer months. These flashboards are removed during the winter. The flow is controlled at the forebay to provide optimum power generating capacity at the powerhouse.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area of Browns Falls Dam is 183.86 square miles.

b. Discharge at Dam Site

No discharge records are available for this site.

Computed discharges:

Ungated spillway, top of dam	8,900 cfs
Ungated spillway, design flood	6,810 cfs 1/2 PMF
Gated drawdown, 12' dia. pipe to powerhouse	990 cfs through turbine units
2, 5.5 x 6.0' sluice gates	2,050 cfs

c. Elevation (Feet above MSL)

Top of dam	1352
Maximum pool - Design discharge	1351.2 1/2 PMF
Spillway crest	1347
Stream bed at centerline of dam	1282
Pipeline invert	1310.7
Sluice gate invert	1310

d. Reservoir

Length of maximum pool	7,500+ ft 1/2 PMF
Length of normal pool	7,000 ft

e. Storage

Normal pool	3,000* acre feet

f. Reservoir Area

Top of dam	157+ acre
Maximum pool	154 acre (1/2 PMF)
Spillway pool	141 acre

*Approximate - assumed volume equal to 1/3 height times top surface.

g. Dam

Type - Concrete, gravity.
Length - 870 feet
Height - 70 feet
Freeboard between normal reservoir and top of dam - 5 feet
Top width - 8 feet
Side slopes - Downstream - 7 vertical/12 horizontal
Zoning - N/A
Impervious core - N/A
Grout curtain - N/A

h. Spillway

Type - Ogee crest
Length - 192 feet
Crest elevation - 1347
Gates -
U/S channel - N/A
D/S channel - N/A

i. Regulating Outlets

Two, 5 feet, 6 inches x 6 feet sluice gates.
12 foot diameter pipeline to power generating station.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The information available for the evaluation of this dam has been included in the report. The information consists of sketches of the dam showing its dimensions, various stability analyses for the existing structure and data provided in a licensed application to the Federal Energy Regulatory Commission.

2.2 CONSTRUCTION

Correspondence between the Owner of the dam and the New York State Department of Conservation is included. This correspondence describes many of the details of the construction and the foundation conditions which existed at the time of construction.

2.3 OPERATION

No Operation Manual is known to exist for this structure.

2.4 EVALUATION

The information available at the time of the inspection is adequate for a Phase I report.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The Browns Falls Dam was inspected on August 12, 1979. The Dale Engineering Company Inspection Team was accompanied on the inspection by Robert Levett and Frank Korbett of the Niagara Mohawk Power Corporation.

b. Dam

The water elevation at the time of the inspection was approximately 6 inches below the top of the flashboards at an elevation of 1348.5. Leakage between the flashboards and the top of the spillway allowed some flow to occur across the spillway surface. The top surfaces of the dam had been recently reconstructed and are in excellent condition. The mechanisms operating the gates to the forebay and the sluice gates which control flow from the impoundment are in excellent condition. The northerly non-spillway section of the dam was overlayed by 1 foot of concrete during the reconstruction program. Some minor leakage is evident at the base of the concrete overlay and spalling and calcium deposits are evident on the surface of the overlay. The spillway section was also repaired during the reconstruction program. Erosion has taken place along both horizontal and vertical joints on the spillway surface, however, this erosion is not severe. The forebay structure was also reconstructed during the renovation program. The southerly non-overflow section is covered with a layer of shotcrete which was placed approximately 40 years ago. Many surface bulges are evident in this shotcrete overlay and soundings indicate that the overlay has become separated from the underlying concrete. A wet spot was noted in the ground in front of the north abutment of the dam approximately 1/2 of the way up the slope. This wet area was not saturated and only surface moisture was noted. No displacement of the structural elements of the dam was noted during the inspection.

c. Appurtenant Structures

Both the forebay sluice gates and the pipeline to the power generating station have been recently reconstructed. These appurtenances are in excellent condition. A small generator is provided at the gatehouse for emergency power to operate the sluice gates.

d. Control Outlet

The twin outlets which control discharge from the dam are in good operating condition. The lower level outlet which would permit draining of the impoundment is presently plugged and is not in operating condition.

e. Reservoir Area

The reservoir extends a distance of approximately 7,000 feet up the Oswegatchie River. There are no known areas of bank instability along this course.

g. Downstream Channel

The downstream channel is formed in bedrock. There is no evidence of recent erosion along this course.

3.2 EVALUATION

The visual inspection revealed minor deterioration on the horizontal and vertical joints of the spillway structure and general deterioration of the shotcrete overlay on the southerly non-overflow section of the dam. Both the sluice gates controlling discharge from the dam and those controlling the flow into the forebay are in excellent condition. A small wet area was noted along the northerly abutment of the structure. There was no evidence of displacement of any of the structural elements of the dam. The low level reservoir drain is inoperative.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The function of this facility is to provide water storage for power generating purposes in the Browns Falls power generating station located approximately 1 mile downstream from the dam. Flashboards are placed on the top of the spillway to provide maximum water storage during the summer months. These flashboards are removed during the winter.

4.2 MAINTENANCE OF THE DAM

Maintenance and operation of the dam is controlled by the Niagara Mohawk Power Corporation. The structure is visited daily and necessary maintenance is undertaken promptly.

4.3 MAINTENANCE OF OPERATING FACILITIES

The gates controlling the flow are maintained by Niagara Mohawk Power Corporation. These gates are presently in excellent operating condition.

4.4 DESCRIPTION OF WARNING SYSTEMS

No warning system is in effect at present.

4.5 EVALUATION

The dam and appurtenant structures are inspected at regular intervals by the Niagara Mohawk Power Corporation. Maintenance has been adequate as evidenced by the recent reconstruction of the structure. Some remedial work should be performed on the shotcrete overlay on the south non-overflow section of the dam in the near future.

SECTION 5 - HYDROLOGIC/HYDRAULIC

5.1 DRAINAGE AREA CHARACTERISTICS

The Browns Falls Dam is located on the Oswegatchie River below the Village of Newton Falls. The river flows northerly from the St. Lawrence/Herkimer County lines with a complex tributary system which meets at Cranberry Lake. It flows westerly and is regulated at the Cranberry Lake outlet and again at Newton Falls before it flows into the Browns Falls Dam Reservoir. The drainage area is approximately 184 square miles. A long term flow record at the Cranberry Lake outlet, 144 square miles, was obtained for this investigation.

5.2 ANALYSIS CRITERIA

The purpose of this investigation is to evaluate the dam and spillway with respect to their flood control potential and adequacy. This has been assessed through the evaluation of the Probable Maximum Flood (PMF) for the watershed and the subsequent routing of the flood through the reservoir and the dam's spillway system. The PMF event is that hypothetical flow caused by the most critical combination of precipitation, minimum infiltration loss and concentration run-off of a specific location that is considered reasonably possible for a particular drainage area. Since the dam is in the Intermediate Size Category and is a High Hazard, the guidelines criteria (Ref. 1) require that the dam be capable of passing the Probable Maximum Flood.

The hydrologic analysis was performed using the unit hydrograph method to develop the flood hydrograph. Due to the limited scope of this Phase I investigation, certain assumptions, based on experience and existing data were used in this analysis and in the determination of the dam's spillway capacity to pass the PMF. In the event that the dam could not pass the 1/2 Probable Maximum Flood without overtopping, an additional analysis is to be performed on potential dam failure if the dam is designated as a High Hazard Classification. This process was done with the concept, that if the dam was unable to satisfy this criteria, further refined hydrologic investigations would be required.

The U.S. Army Corps of Engineers' Hydrologic Engineering Center's Computer Program HEC-1 DB using the Modified Puls Method of flood routing was used to evaluate the dam, spillway capacity, and downstream hazard.

Unit hydrographs were defined by Snyder coefficients, Tp and Cp. The drainage area was divided into sub-areas according to the slope of the terrain. Run-off, routing and flood hydrograph combining was then performed as inflow to the reservoir.

The Probable Maximum Precipitation (PMP) was 18.5 inches according to Hydrometeorological Report (HMR #33) for a 24-hour duration, 200

square mile basin, while loss rates were set at 1.0 inches initial abstraction and 0.1 inches/hour continuous loss rate. The loss rate function yielded 82 percent run-off from the PMF.

5.3 SPILLWAY CAPACITY

The spillway is a weir type structure 192 feet in length. The spillway coefficient varied between 3.30 and 4.15 for the spillway rating curve development. Immediately behind the spillway, flows discharge down a steeply grade natural bedrock channel. The overall discharge capability of the spillway at the top of dam elevation is 8910 cfs.

SPILLWAY CAPACITY

	Discharge	Capacity as % of PMF
PMF	13,703 cfs	65%
1/2 PMF	6,810 cfs	130%

5.4 RESERVOIR CAPACITY

The reservoir storage capacity is given below. This was estimated for USGS mapping.

Top of Dam — 744 Acre Feet Above Normal Pool

5.5 FLOODS OF RECORD

There was no information available on water levels at the dam site. The annual peak record at gate 04261000 at Cranberry Lake is included in Appendix C. That record indicates that the flood of record for the period of 1923-1975 was 1940 cfs.

5.6 OVERTOPPING POTENTIAL

The HEC1-DB analysis indicates that the dam will be overtopped as follows:

OVERTOPPING IN FEET

PMF	1.03 Feet
1/2 PMF	None

5.7 EVALUATION

The analysis performed herein is in general agreement with previously published discharges and the dam would be overtopped by 1 foot under a PMF event. The dam would not be overtopped by a 1/2 PMF event. According to the Recommended Guidelines for Safety Inspection of Dams, the spillway is inadequate.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

This concrete gravity dam shows no evidence of cracking, fracture or other movements indicative of structural instability.

This dam is comprised of a non-overflow section (left section of dam looking downstream) which forms approximately the southerly half to two-thirds of the total structure's length, a spillway section and a non-overflow - abutment section for the northerly-most (right end) segment.

The dam's crest walkway and downstream faces have been rehabilitated/resurfaced at different times in the past, the most recent being the crest area of the dam's left section and the downstream face of the right northerly non-overflow section. The concrete exposed in these zones is generally in good condition. Concrete exposed in the spillway section is also generally in good condition, but some horizontal construction joints show some deterioration. The downstream face of the dam's southerly left section was resurfaced (shotcrete) a number of years past (on the order of twenty to thirty years) and this veneer is cracked and apparently separating from the main structural section (the material is buckled with a hollow sound when tapped) at a number of locations. The weather was rainy at the time of this inspection, masking signs of any through-the-dam seepage. It does appear that minor seepage occurs through this southerly section of dam at some locations. There also exists signs of seepage through the lower segment of the dam's northerly non-overflow section.

The application for construction of this dam (1922) includes a report* by the design engineer which indicates the dam is founded on bedrock with the exception of the northerly (right) abutment segment which is founded on the very dense and compact soils (probable glacially compacted soil) underlying that area of the dam site. It is possible that the seepage noted in the vicinity of the dam's right abutment could be originating as flow through that area's foundation soils.

*"Report with Application, Dam on Oswegatchie River at Browns Falls, Town of Clifton, St. Lawrence County, N.Y.," by James B. Brownell, C.E., Consulting Engineer, Carthage, N.Y., dated May 26, 1972.

The 1922 report and design drawings indicate the presence of an older concrete dam which was incorporated into the presently-existing structure. The original dam had its crest on the order of 30 to 35 feet below the present structure's crest. It is possible that the various locations of noted or suspected through-the-dam seepage could be originating along the construction joint between the old and new dam sections.

The dam was inspected with the reservoir elevation at the normal operations level. None of the dam's upstream zones were visible for evaluation.

Concrete deterioration is occurring in the section of tunnel which comprises the spillway overflow outletting at the spillway section's downstream toe.

b. Geology and Seismic Stability

Browns Falls Dam is located in the Fall Zone section of the western part of the Adirondack Province. The dam is sited on bedrock which is a microline granite gneiss of Precambrian age. Foliation trends N45-50W and dips 30-50S. The trend of foliation is close to perpendicular to the orientation of the dam.

According to the 1922 report by Brownell (page 2), the dam was to be founded entirely upon solid rock, excepting the key into the right bank (as viewed looking downstream). Two inch anchor pins were to be placed in the rock as an additional factor of safety. The north bank, according to Brownell (1922, p. 3), consists of a dense compact sand which was difficult to excavate. Bedrock was to be followed until about under the reservoir shoreline beyond which contact was to be on the compact sand of the right bank. The site's rock is considered durable, of reasonable strength relative to crushing, and relativly impermeable.

The New York State Geological Map (1970) shows no faults present in the immediate area. No porous seams, fissures, shear zones or fracturing were observed. The Preliminary Brittle Structures Map of New York (1977) does show several lineaments of unknown origin in the area. A one mile wide mouth trending shear zone, about six miles west of the dam, is present.

Although numerous minor earthquakes have been recorded in the region, the only earthquake of significance (V on the Modified Mercalli Scale) occurred about 27 miles north of the dam in 1922. In 1974, nine minor earthquakes were recorded as having occurred in the region between 13 and 19 miles north of the reservoir, and 102 events were recorded in the Blue Mountain Lake Region, about 32 miles to the southeast.

The area is designated as being in Zone 2 of the Seismic Probability Map. Medium intensity earthquakes of VI-VII (Modified Mercalli) are considered probable and even higher intensity possible.

c. Data Review and Stability Evaluation

Design drawings available for review show plan layout and cross-sections for the various structural elements comprising the dam but do not include information on the properties of the dam and foundation materials, nor stability analysis performed for that design. As part of the present study, stability evaluations have been performed for the dam/spillway sections. Stability analysis have also been performed by the firm of Uhl, Hall and Rich in the recent past (date included in Appendix - B and are in general agreement with the analysis undertaken as part of the present investigation. Actual properties of the dam's construction materials and foundations were not determined as part of this study; where information on properties were necessary for computations, but lacking assumptions felt to be practical were made. These stability computations assumed a dam cross-section based on dimensions indicated by the plans included in this report. The analysis also assumed the dam section (actually comprised of an old and new section) to be a monolith possessing necessary internal resistance to shear and bending occurring as a result of loading. It should be considered that in areas where deterioration has occurred, section dimensions would be less than indicated by the plans, with some adverse effect on the structural strength expected.

The results of the stability computations are summarized in the table which follows. The stability analysis are included in Appendix D.

RESULTS OF STABILITY COMPUTATIONS

	Loading Condition	Factor of Safety: Overturning	Factor of Safety: Sliding	Location of Resultant Passing through Base
(I)	Water elevations at normal operating levels, uplift on base plus 10 kip per lineal foot ice load acting			
	(a) spillway section	1.21±	5±	0.18b
	(b) non-overflow section, dam's right segment	1.35±	10±	0.24b
(II)	Water elevations at 1/2 PMF levels, uplift acting on base as computed for normal operating conditions.			
	(a) spillway section	1.23±	4±	0.19±
	(b) non-overflow section, dam's right segment	1.40±	9±	0.27b
(III)	Water elevations at PMF levels, uplift acting on base as computed for normal operating conditions.			
	(a) spillway section	1.19±	5±	0.16b
	(b) non-overflow section, dam's right segment	1.36	8±	0.25b

The analysis indicate unsatisfactory stability against overturning, according to the Recommended Guidelines for Safety Inspection of Dams, for the cases of the dam subject to forces possible during normal operation, the 1/2 PMF, and the PMF conditions (where the resultant of forces acting on the dam is located outside of the middle-third of the base, tensile stresses would develop in the dam section, a structurally undesirable condition).

Critical to the analysis and resulting indication of stability are the items of uplift water pressures acting on the base of the dam and the relative permeability of the site's foundation rock. For the "normal operating conditions" case, the analysis uplift force was based on a full headwater hydrostatic pressure acting on the dam's upstream corner and a zero tailwater hydrostatic pressure acting at the dam's downstream corner. Uplift pressures were assumed to vary linearly between the dam's upstream and downstream corners, and act upon 100 percent of the dam base. The resulting uplift represents a condition that is significant in arriving at the computed unsatisfactory resistance to overturning forces.

The 1922 design report indicates that 2 inch anchor pins would be utilized to tie the dam section to the rock foundation. Information on the number and location of such anchors was not available for the stability analysis performed and affects were not included in the stability evaluation. Properly installed anchor pins would increase the dam's resistance to overturning and sliding.

It is recommended that engineering studies be performed to fully evaluate the uplift forces acting at the base of the dam and within the dam section. This engineering investigation should extend to evaluating the physical properties of the dam concrete and the installation of the anchor pins, factors necessary for precision stability studies and important to planning necessary structural improvements. Studies should include investigation of the dam's upstream face, to evaluate the structural condition of that section of the dam and the integrity of the connection between old and new sections.

The condition of the shotcrete surface on the downstream face of the dam's left section should be investigated by coring or similar resulting procedure to determine the need for repair/replacement. Plans for concrete repair should extend to the spillway tunnel.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

The Phase I inspection of the Browns Falls Dam on the Oswegatchie River did not indicate conditions which constitute an immediate hazard to human life or property. The visual inspection revealed minor deterioration on horizontal and the vertical joints of the spillway structure, and a general deterioration of the shotcrete overlay on the southerly non-overflow section of the dam. A wet area indicating seepage was noted along the northerly abutment of the structure at an elevation approximately one-half the height of the dam.

The hydrologic/hydraulic analysis indicates that the dam would be overtopped by 1 foot under a Probable Maximum Flood event but has capacity to pass the 1/2 PMF. According to the Recommended Guidelines for Safety Inspection of Dams, the spillway is inadequate. The structural analysis indicates unsatisfactory stability against overturning according to the Recommended Guidelines for Safety Inspection of Dams, for the cases of the dam subject to forces possible during normal operation (including ice loading), the 1/2 PMF and the PMF conditions. Under each of these conditions, the resultant of forces acting on the dam is located outside the middle third of the base indicating that tensile stresses would develop in the dam section.

b. Adequacy of Information

The information available is adequate for this Phase I Inspection Report.

c. Urgency

The deteriorated shotcrete surface on the south non-overflow section of the dam may conceal defects in the original concrete structure. Seepage along the toe of the north abutment could increase with time. Therefore, the investigations recommended below should be undertaken immediately and remedial work should be completed within two years.

d. Need for Additional Investigation

Additional investigations should be undertaken to fully evaluate the uplift forces acting at the base of the dam and should extend to the evaluation of the physical properties of the dam concrete and the installation of anchor pins in the foundation. The investigation should also evaluate the structural condition of the old dam and the integrity of the connection between the old and new sections. The condition of the reservoir drains should be investigated and the necessary work should be performed to place the drain in operation.

7.2 RECOMMENDED MEASURES

The following steps should be undertaken:

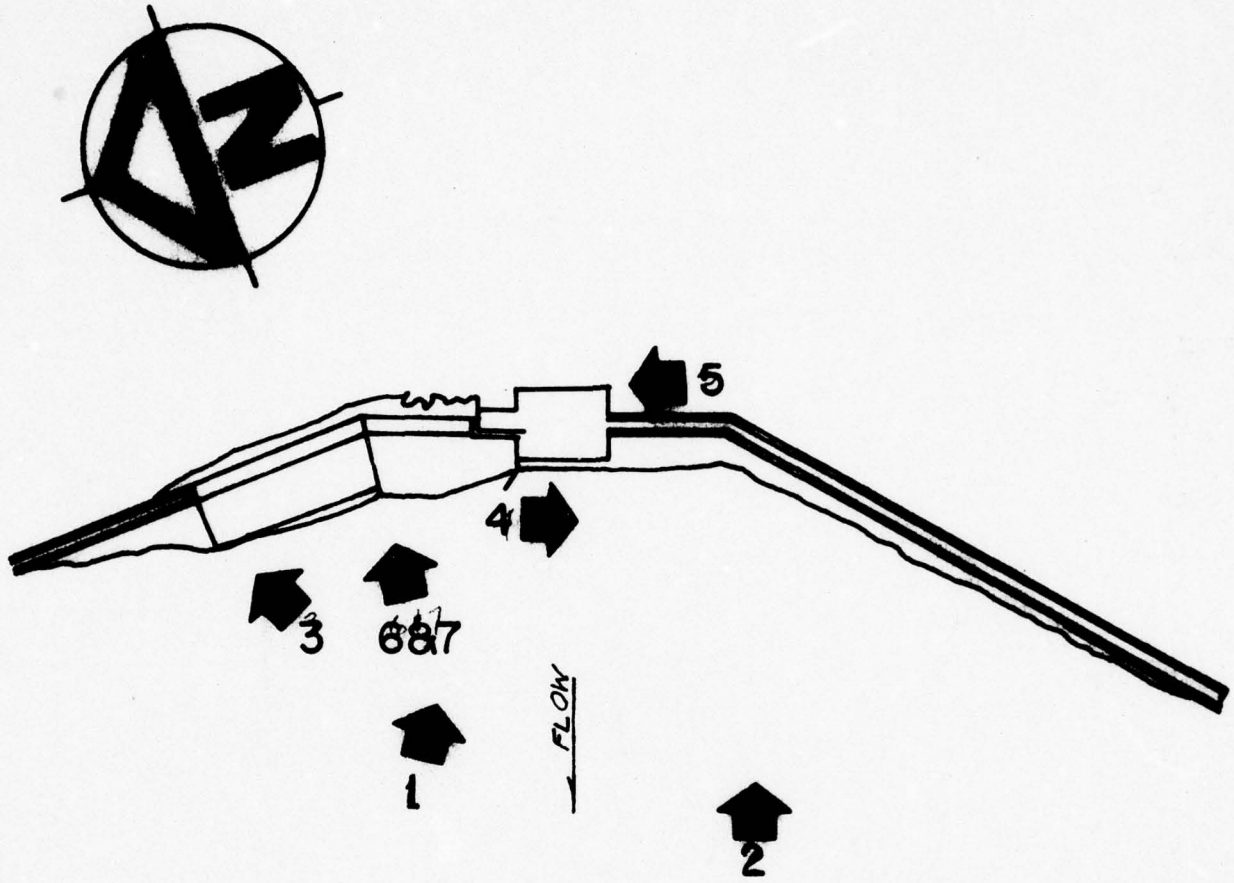
1. Complete the aforementioned structural stability investigations.

2. Undertake any repairs necessary as indicated by the detailed structural evaluations.

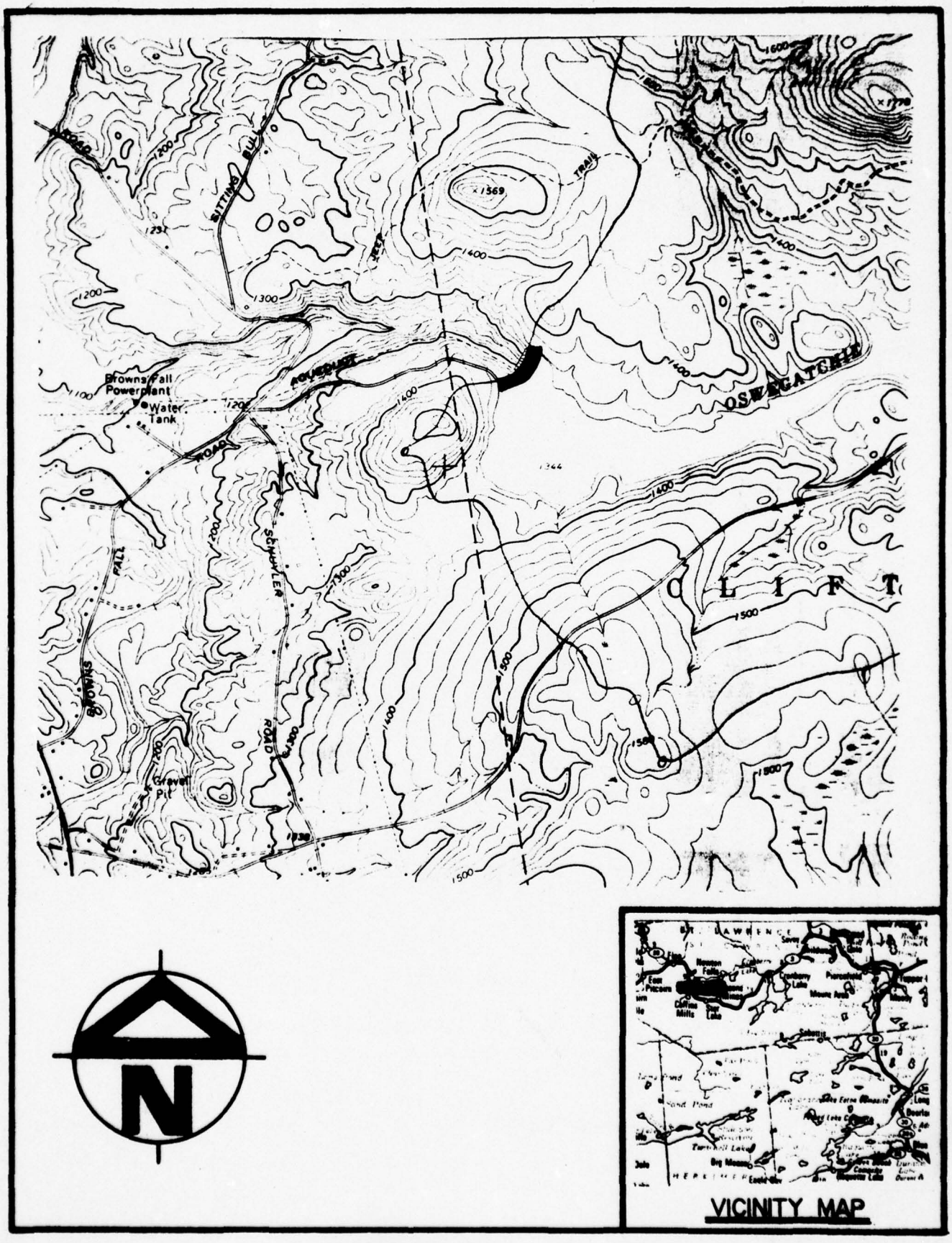
3. Monitor the seepage occurring at the north abutment and investigate the source of this seepage.

4. Complete the necessary remedial work to eliminate this seepage, should the investigation indicate that dangerous conditions exist.

5. The condition of the concrete beneath the deteriorated shotcrete surface on the south non-overflow section should be investigated. Remedial work should be undertaken to correct any concealed defects in the original concrete structure.

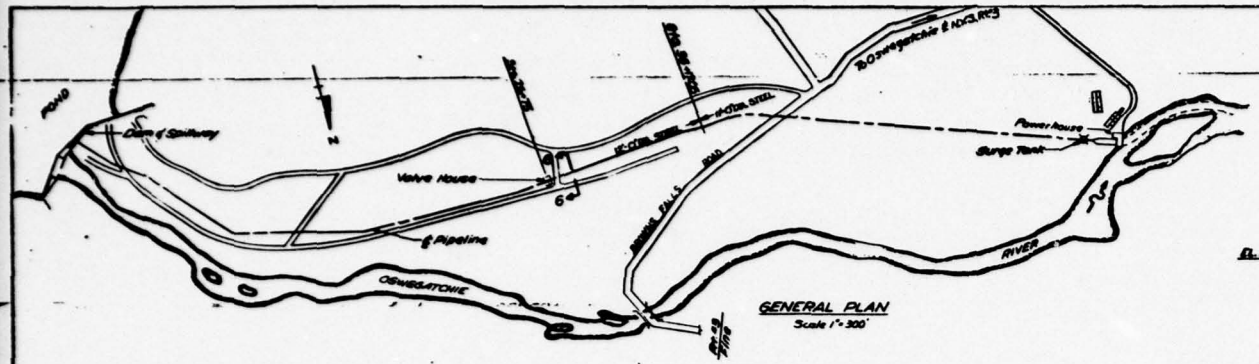


PHOTOGRAPHIC KEY MAP

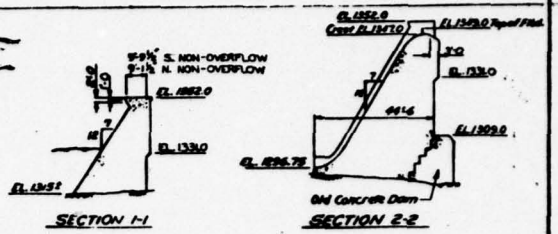


LOCATION PLAN

FIGURE 1

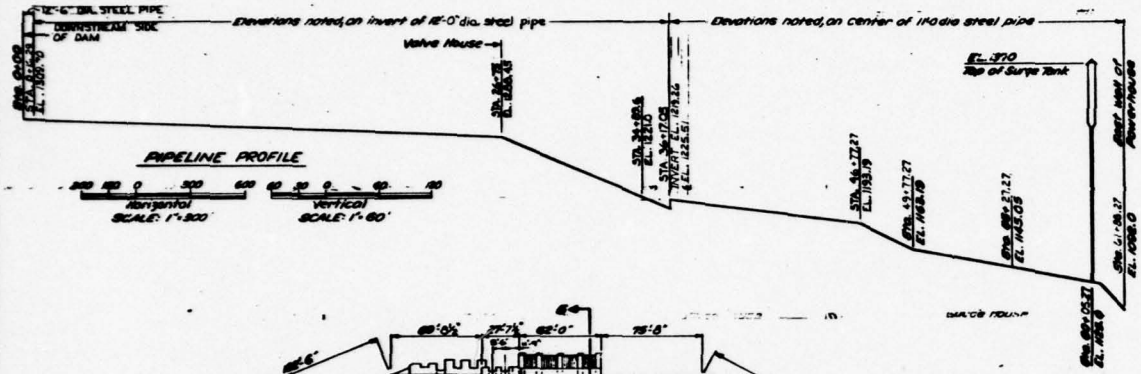


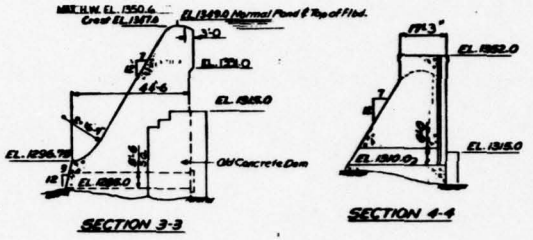
GENERAL PLAN
Scale 1" = 300'



SECTION 1-1

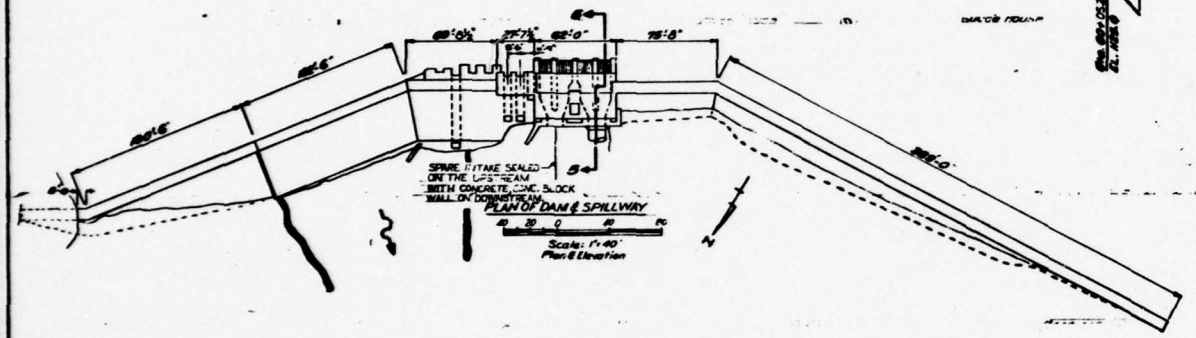
SECTION 2-2

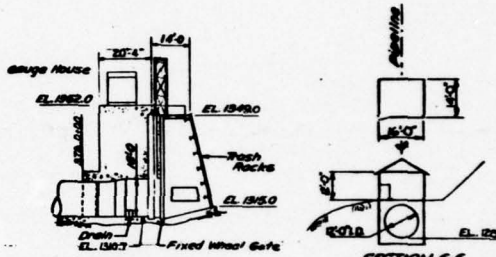




SECTION 3-3

SECTION 4-4

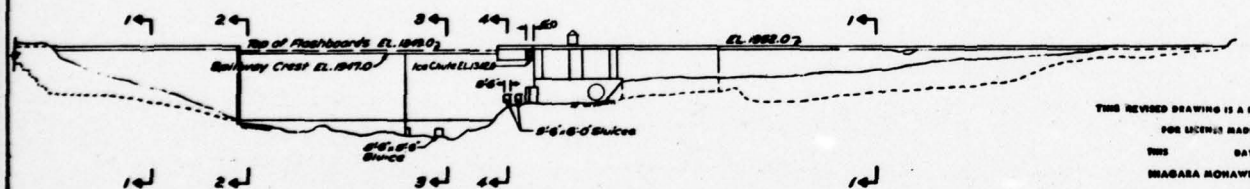




SECTION 5-5

SECTION 6-6
Valve House
Sta. 26+75

Scale: 1" = 20'
SECTIONS H I N & 6



ELEVATION OF DAM & SPILLWAY

THIS REVISED DRAWING IS A PART OF THE APPLICATION FOR LICENSE MADE BY THE UNDERSIGNED

THIS DAY OF

NIAGARA MOHAWK POWER CORPORATION

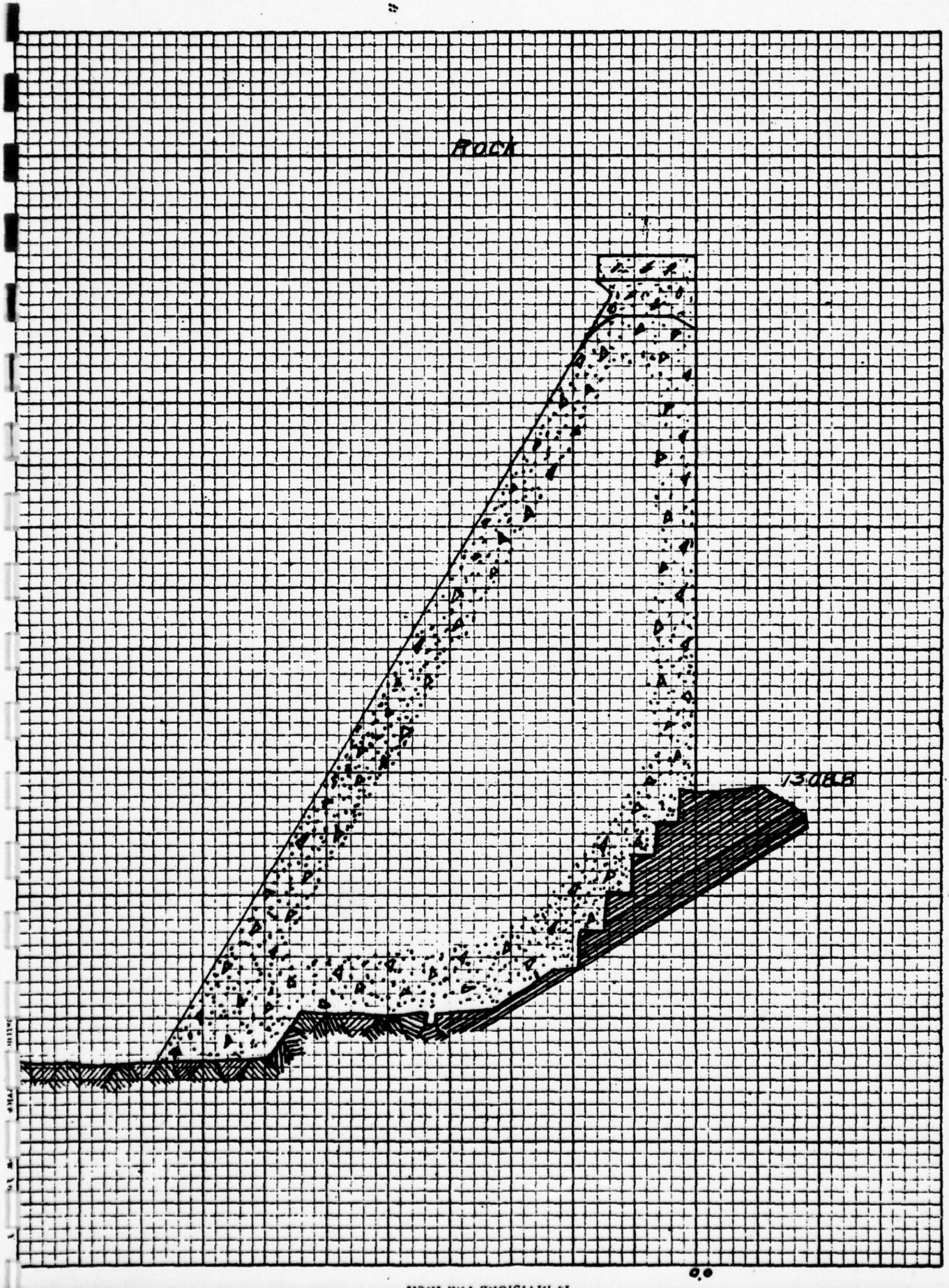
BY

TITLE

NIAGARA MOHAWK POWER CORPORATION
SYRACUSE, N.Y.

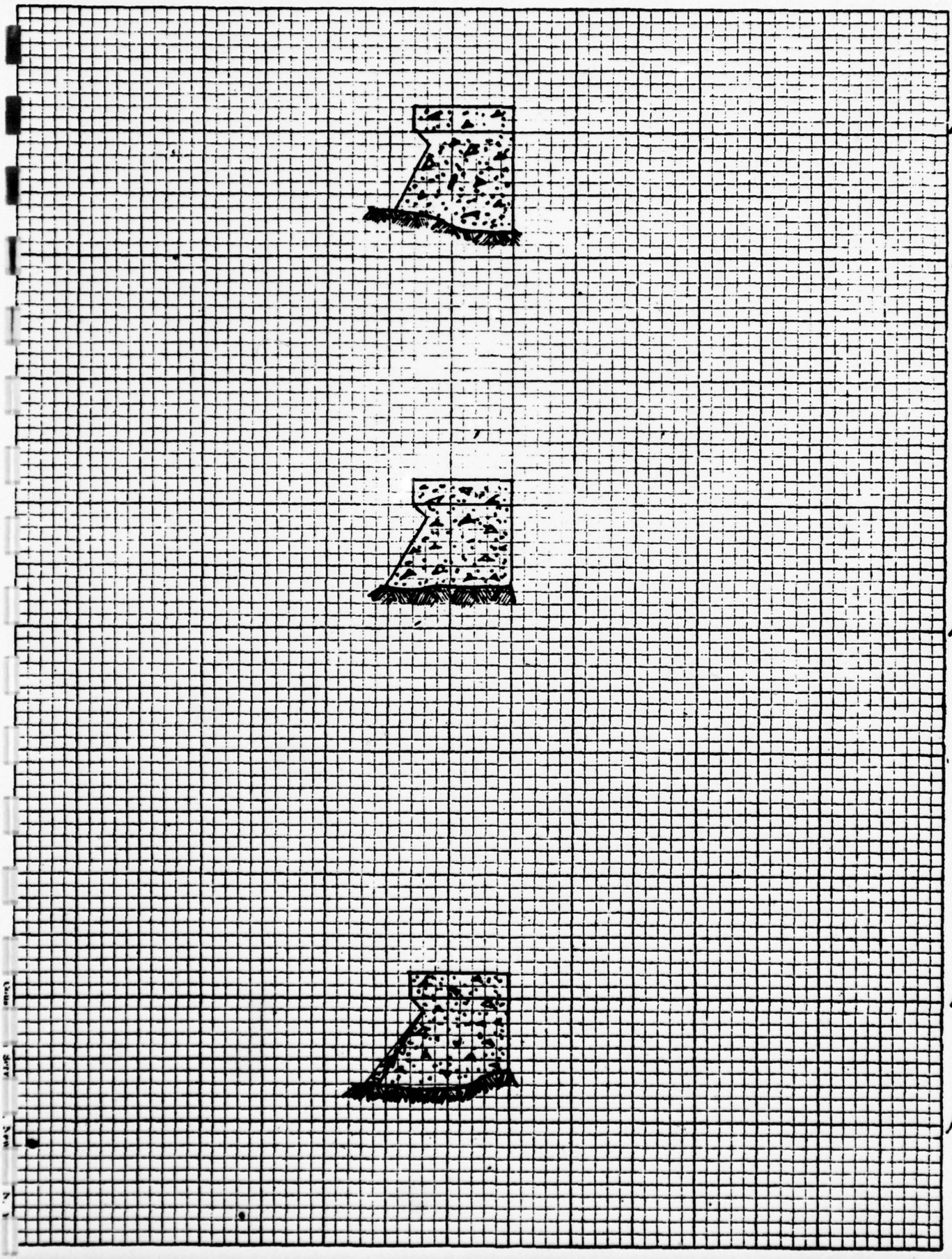
CONSTRUCTED OSWEGATCHIE RIVER PROJECT
BROWNS FALLS DEVELOPMENT
GENERAL PLAN - DAM, SPILLWAY, INTAKE AND PIPELINE
PLAN, PROFILE, ELEVATIONS AND SECTIONS
EXHIBIT L SHEET NO 1A

FIGURE 2



10 DIVISIONS PER INCH

FIGURE 3



10 DIVISIONS PER INCH

FIGURE 4

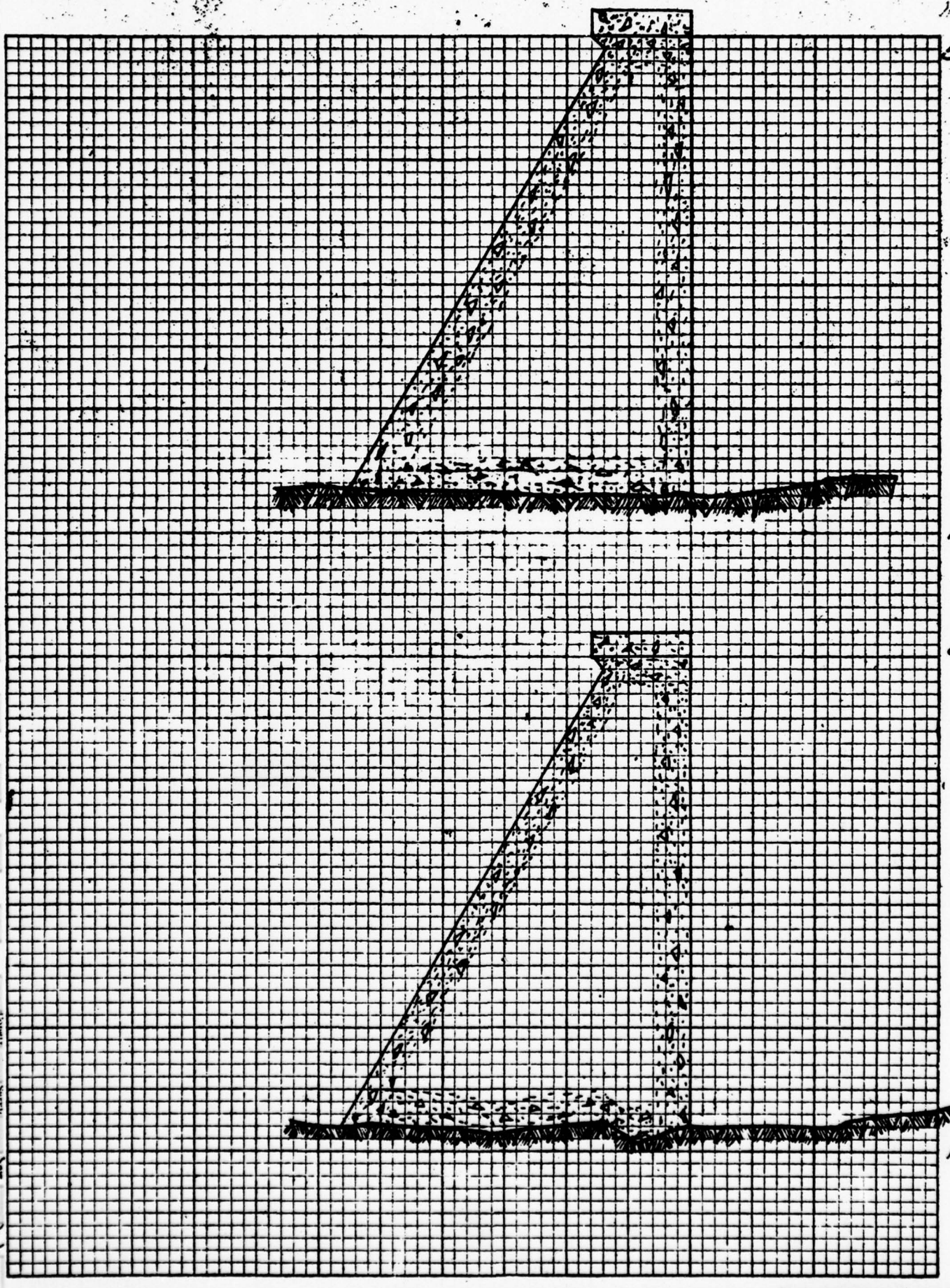


FIGURE 5

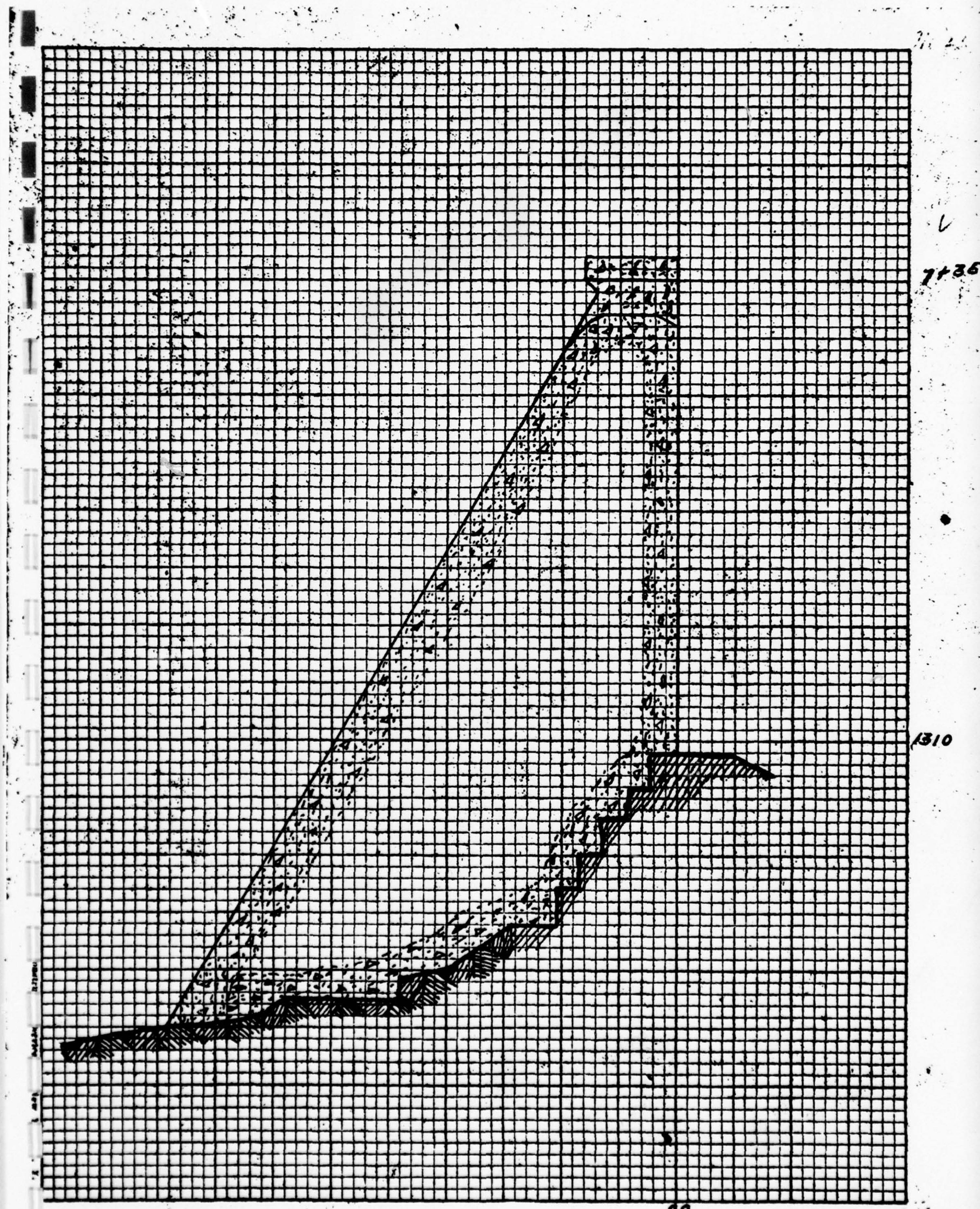
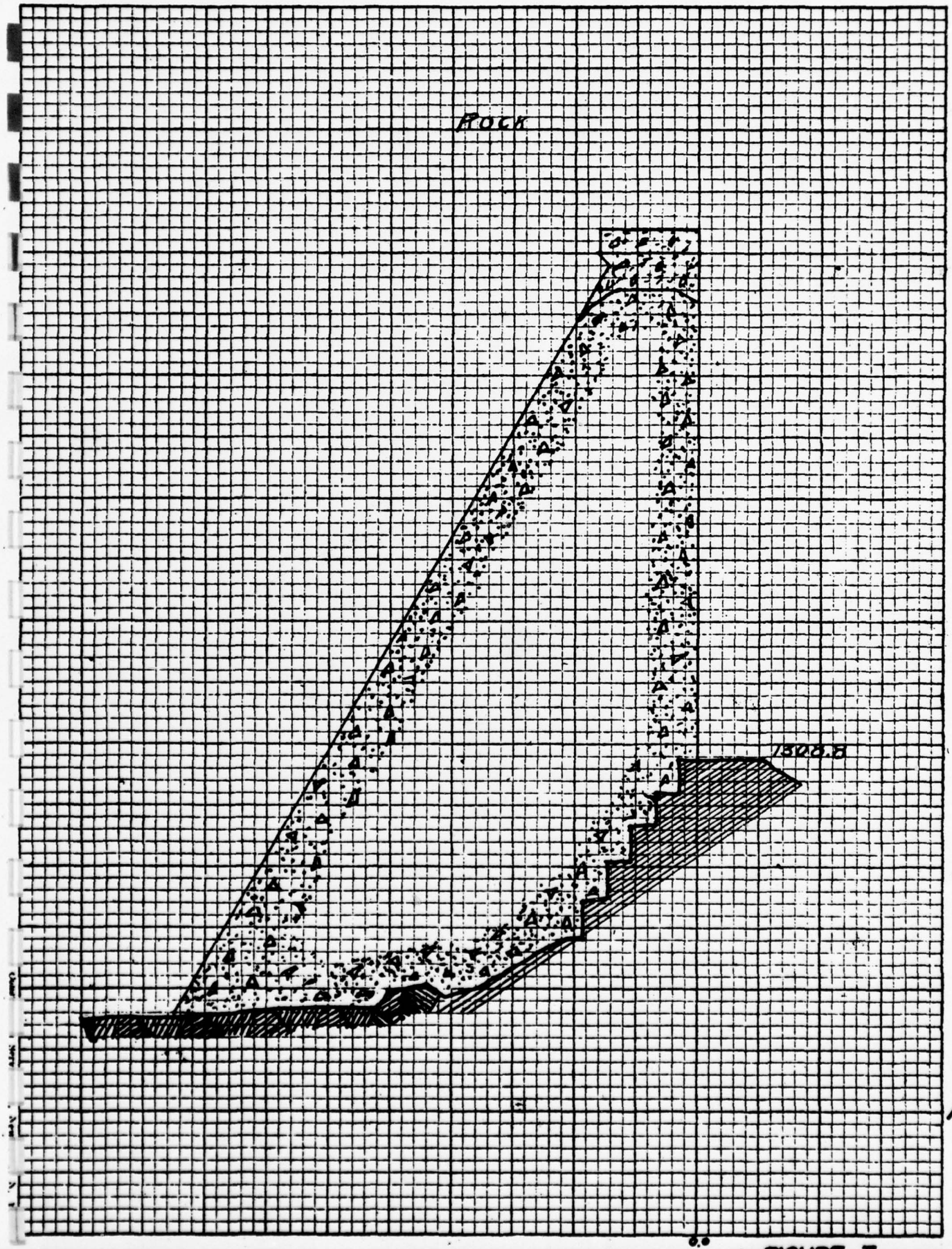


FIGURE 6



10 DIVISIONS PER INCH

FIGURE 7

APPENDIX A

FIELD INSPECTION REPORT

CHECK LIST
VISUAL INSPECTION

PHASE 1

Name Dam Brown's Falls Dam County St. Lawrence State New York ID # NY762

Type of Dam Concrete Gravity Hazard Category High

Date(s) Inspection August 12, 1979 Weather Rain Temperature 60's

Pool Elevation at Time of Inspection 1348.5 M.S.L.
6 in. below flashboards

Tailwater at Time of Inspection None
All flow through pipeline to powerhouse.

Inspection Personnel:

N. F. Dunlevy	Dale Engineering Company	
F. W. Byszewski	Dale Engineering Company	
D. F. McCarthy	Dale Engineering Company	
H. Muskatt	Dale Engineering Company	
Frank Korbett	Niagara Mohawk Power Corporation	Potsdam, New York
Robert Levett	Niagara Mohawk Power Corporation	Syracuse, New York

N. F. Dunlevy Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	North section of dam below new concrete overlay at base of dam. Also through forebay wall. The main spillway had a slight amount of leakage through flash-boards and seepage could not be detected.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	North section has core wall into em-bankment. Junctions largely founded on rock.	
DRAINS	Main spillway had drains installed below shotcrete. Most drains appear clogged.	
WATER PASSAGES	Stop log passage had slight amount of leakage and discharge over dam.	
FOUNDATION	Bedrock observed.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Main spillway shotcrete has some cracks. Large crack over low level outlet. South section shotcrete surface has cracks.	
STRUCTURAL CRACKING	Cannot be observed below shotcrete. Hammering of surface indicates shotcrete surface may not be applied directly to dam surface since a hollow sound can be heard.	
VERTICAL & HORIZONTAL ALIGNMENT	Good alignment even through shotcrete has been used.	
MONOLITH JOINTS	Not observed	
CONSTRUCTION JOINTS	On the north section of dam, the joints have some leakage and calcium deposits on surface.	
STAFF GAGE OF RECORDER	Not observed at dam	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	N/A	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	N/A	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	N/A	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	N/A	
RIPRAP FAILURES	N/A	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	N/A	
ANY NOTICEABLE SEEPAGE	N/A	
STAFF GAGE AND RECORDER	N/A	
DRAINS	N/A	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Center portion of dam across deep section. Spillway was shotcreted. Some surface deterioration mostly along construction joints.	
APPROACH CHANNEL	Reservoir.	
DISCHARGE CHANNEL	Main river channel	
BRIDGE AND PIERS	None	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	None	
APPROACH CHANNEL	None	
DISCHARGE CHANNEL	None	
BRIDGE AND PIERS	None	
GATES AND OPERATION EQUIPMENT	None	

OUTLET WORKS

Twin sluice gates and pipeline to hydropower facility downstream

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	No observation	
INTAKE STRUCTURE	In main dam structure	
OUTLET STRUCTURE	Twin sluice gate discharge into spillway. Pipeline travels 6000 feet to power house downstream.	
OUTLET CHANNEL	Main river channel	
EMERGENCY GATE	---	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Unobstructed, no debris. Bedrock channel bed.	
SLOPES	Steeply sloped (200 feet in a mile).	
APPROXIMATE NO. OF HOMES AND POPULATION	Powerhouse downstream. Below powerhouse village of Fine is located in flood plain.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	Not observed.	
OBSERVATION WELLS	Not observed.	
WEIRS	Not observed.	
PIEZOMETERS	Not observed.	
OTHER	---	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Well sloped but treed	
SEDIMENTATION	None observed.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE 1

NAME OF DAM Brown's Falls

ID # _____

ITEM	REMARKS
AS-BUILT DRAWINGS	See this report.
REGIONAL VICINITY MAP	See this report.
CONSTRUCTION HISTORY	No data obtained for this report.
TYPICAL SECTIONS OF DAM	See this report.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	See this report.
RAINFALL/RESERVOIR RECORDS	See Niagara Mohawk Corporation.

ITEM	REMARKS
DESIGN REPORTS	None available for this report
GEOLOGY REPORTS	None available for this report
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Licensing application to FERC. given in this report.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Liscensing application to FERC. given in this report.
POST-CONSTRUCTION SURVEYS OF DAM	Licensing application to FERC. given in this report.
BORROW SOURCES	---

ITEM	REMARKS
MONITORING SYSTEMS	No data
MODIFICATIONS	No data
HIGH POOL RECORDS	No data
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	FERC licensing application See this report.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION: RECORDS	See Niagara Mohawk Corporation.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	See this report
OPERATING EQUIPMENT PLANS & DETAILS	See this report and contact Niagara Mohawk Corporation.

CHECK LIST
HYDROLOGIC & HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 178 sq. mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1341

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): ---

ELEVATION MAXIMUM DESIGN POOL: ---

ELEVATION TOP DAM: 1352

CREST:

a. Elevation: 1349 w/ flashboard, 1347 w/o flashboard
b. Type: crested spillway
c. Width: see plans this report
d. Length: 192.2
e. Location Spillover: Center of dam
f. Number and Type of Gates: 2 sluice gates.

OUTLET WORKS:

a. Type: 2 sluice gates 5'-6" x 6'-0" ea.
b. Location: Center of dam
c. Entrance Inverts: See plans
d. Exit Inverts: See plans
e. Emergency Draindown Facilities: ---

HYDROMETEOROLOGICAL GATES:

a. Type: ---
b. Location: ---
c. Records: ---

MAXIMUM NON-DAMAGING DISCHARGE: ---

APPENDIX B

PREVIOUS INSPECTION REPORTS/RELEVANT CORRESPONDENCE

NIAGARA MOHAWK

NIAGARA MOHAWK POWER CORPORATION/300 ERIE BOULEVARD WEST, SYRACUSE, N.Y. 13202/TELEPHONE (315) 474-1511

August 22, 1979

Mr. Neal F. Dunlevy
Stetson-Dale
Bankers Trust Building
Utica, New York 13501

Subject: Browns Falls Dam National Dam
Safety Inspection

Dear Neal:

Enclosed is one copy each of the following items:

1. Pages 2, 3, 5 and 6: Plates I, II, III, IV and V from the Uhl, Hall and Rich Report on "Spillway Adequacy and Stability Analysis for Constructed Oswegatchie River Project."

2. Exhibit I from the License Application to the Federal Energy Regulatory Commission.

3. Spillway Rating Curve for the School Street Hydro Station on the Mohawk River.

If I can be of any further help, please feel free to call me.

Very truly yours,

Robert J. Levett

Robert J. Levett

RJL/kmb
Enclosures

SPILLWAY ADEQUACY

Browns Falls Development

The Probable Maximum Flood (PMF) for the Development's drainage area, 178 square miles, was derived using the data available in the joint "U. S. Corps of Engineers - U. S. Weather Bureau Hydrometeorological Report No. 33". For a 48-hour storm, the Probable Maximum Precipitation (PMP) was computed to be 18.7 inches. By applying infiltration assumptions, the total runoff was determined to be 13.5 inches. Since 144 square miles of the Development's catchment is regulated by Cranberry Lake, the U.S.G.S. gage at the lake outlet, with a period of record from 1923 to date, measures only the regulated flow. Because this gage record reflects only regulated flow, the U.S.G.S. gage on the West Branch of the Oswegatchie near Harrisville, New York, commanding a drainage area of 258 square miles and having a period of record dating from 1916, was used to develop a unit hydrograph for this flood study.

The table below shows the theoretical return period - annual peak flow as derived for the gage on the West Branch of the Oswegatchie and prorated to the Cranberry Lake inflow.

Return Period - Years	Annual Peak Flows - cfs
2	3,000
5	3,700
10	4,300
20	4,700
50	5,300
100	5,700
500	6,800
1,000	7,000

A Standard Project Flood (SPF) of 60 percent of the PMF was adopted for this study and the flood was routed through Cranberry Lake, upstream of the Development. The Flood Discharge Capacity curve as given on Sheet No. 2 of the Exhibit "L" drawings was used in this analysis. The peak (SPF) inflow to Cranberry Lake of 10,000 cfs was reduced to a peak outflow of 4,400 cfs as a result of this routing.

The routed outflow of Cranberry Lake was taken as the Development's inflow after base inflow for the intervening area was added. The peak inflow to the Development was computed as 4,800 cfs and this value was reduced to a peak outflow of 4,750 cfs with a freeboard of 1.4 feet; thus showing how little effective storage is available at the Development.

In order to determine the SPF tailwater elevation to be used in this study, the hydraulics of the downstream channel were investigated and a tailwater elevation of 1297.5 was computed for this case.

The hydrographs for the SPF routing are given on Plate V of Appendix A.

Flat Rock Development

The Probable Maximum Flood (PMF) for the Development's drainage area, 262 square miles, was derived using the data available in the joint "U. S. Corps of Engineers - U. S. Weather Bureau Hydrometeorological Report No. 33". For a 48-hour storm, the Probable Maximum Precipitation was computed to be 19.0 inches. After applying infiltration assumptions, the total runoff was computed to be 13.8 inches.

The U.S.G.S. gage on the West Branch of the Oswegatchie near Harrisville, New York, commanding a drainage area of 258 square miles with very little regulation and having a period of record from 1916 to the present, was used to develop the unit hydrograph used in this study. The 13.8 inches of runoff was then applied to the developed unit hydrograph to derive a PMF hydrograph.

The PMF hydrograph for the intervening drainage area between the upstream Browns Falls Development and the subject Development was reduced to sixty percent in order to arrive at a Standard Project Flood (SPF) for this area.

The SPF hydrograph was then superimposed on the routed SPF outflow from the Browns Falls Development to produce a peak inflow to the Flat Rock Development of 11,325 cfs. The combined SPF hydrograph was routed through the Flat Rock reservoir with a normal operating level of El. 1079 at the beginning of the storm. The Flood Discharge Capacity Curve as given on Sheet No. 3 of the Exhibit "L" drawings was used in this analysis and extended to cover the range of discharge and elevation considered. Plate XVII of

OVERTOPPING

Browns Falls Development

The possibilities of overtopping were studied and were not considered in view of the magnitude of the SPF which the Development would pass and the very small storage volume, 1,200 acre-feet, which if released downstream by failure would probably cause very little incremental damage over that caused by the normal flood.

Flat Rock Development

The possibilities of overtopping were studied and were not considered in view of the magnitude of the SPF which the Development would safely pass, and also because of the fact that the non-overflow section, also of concrete, would allow the safe transit of an even greater flood.

The possibility that the failure of the Development from a flood would add to the downstream damage that would occur from such a flood is very remote.

South Edwards Development

The possibilities of overtopping were studied and were not considered in view of the magnitude of the SPF that the Development would safely pass.

The possibility that the failure of this Development from a flood would add to the downstream damage that would occur from such a flood is most remote.

STABILITY OF STRUCTURES

Browns Falls Development

A stability analysis of all water retaining structures was performed for normal operating conditions, ice conditions, seismic conditions, and flood conditions.

Plate I depicts the sections chosen for analysis. Plates II and III outline the cases and the design assumptions used. Plate IV summarizes in tabular form the values derived from the analysis. All plates are found in Appendix A.

Based on the results of the analysis performed, we find the Development's structures are stable against the expected loadings as assumed.

Flat Rock Development

A stability analysis of all water retaining structures was performed for normal operating conditions, ice conditions, seismic conditions, and flood conditions.

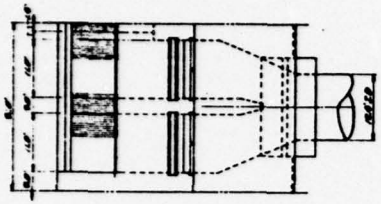
Plate VI depicts the sections chosen for analysis. Plates VII and VIII outline the cases and the design assumptions used, and Plate IX summarizes in tabular form the values derived from the analysis. All plates are found in Appendix B.

Based on the results of the analysis performed, we find the Development's structures are stable against the expected loadings as assumed.

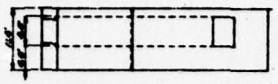
South Edwards Development

A stability analysis of all water retaining structures was performed for normal operating conditions, ice conditions, seismic conditions, and flood conditions.

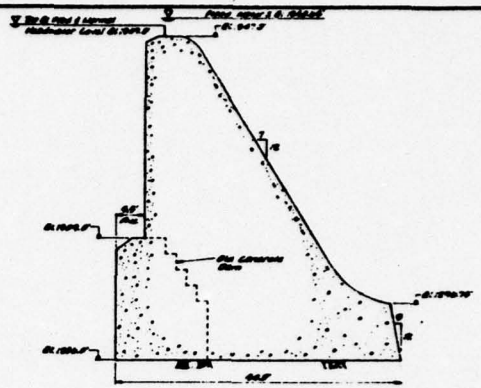
Plate XI depicts the sections chosen for analysis. Plates XII and XIII outline the cases and the design assumptions used. Plate XIV summarizes in tabular form the values derived from the analysis. All plates are found in Appendix C.



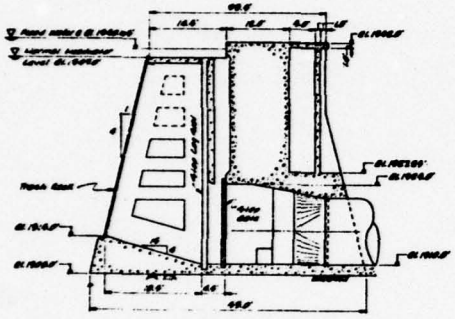
PLAN OF INTAKE BLOCK



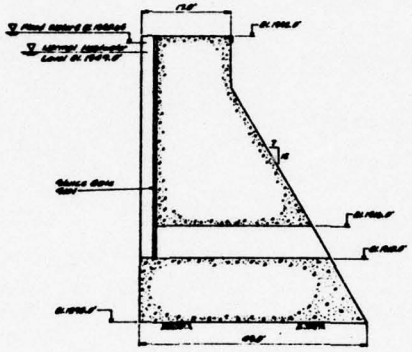
PLAN OF SLUICE BLOCK



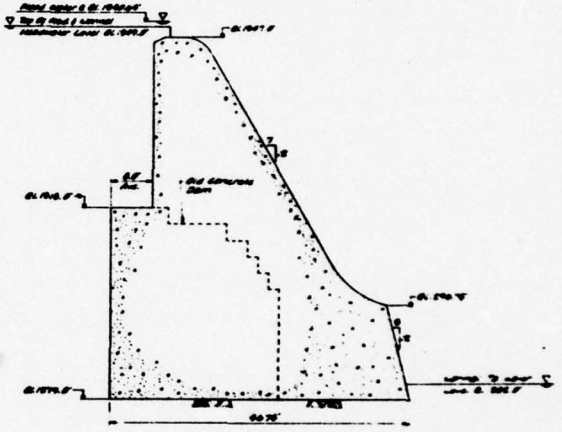
SPILLWAY SECTION
(SECTION 2-2)



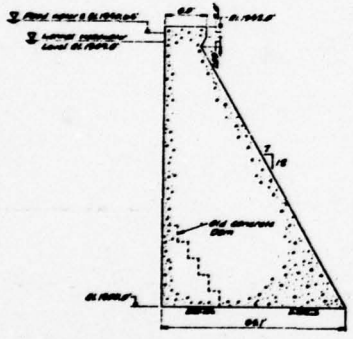
SECTION THRU INTAKE BLOCK
(SECTION 5-5)



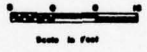
SECTION THRU SLUICE BLOCK
(SECTION 4-4)



SPILLWAY SECTION
(SECTION 3-3)



SECTION THRU NON-OVERFLOW SECTION
(SECTION 1-1)



Scale in Feet

NIAGARA MOHAWK POWER CORPORATION
SYRACUSE, N.Y.
CONSTRUCTED OSWEGATCHIE RIVER PROJECT
GROUND FALLS DEVELOPMENT
F.P.C. PROJECT NO 2713

CONCRETE SECTIONS ANALYZED FOR STABILITY

UHL, HALL & RICH

PLATE I

CONSTRUCTED OSWEGATCHIE RIVER PROJECT

BROWNS FALLS DEVELOPMENT

CASES USED IN STABILITY ANALYSIS

CONCRETE SECTIONS

CASE I Normal Operating Levels
H.W.L. = 1349.0; T.W.L. = 1282.0

CASE II Ice Load
Sections 1-1, 4-4, and 5-5; H.W.L. = 1349.0
Ice @ Elev. 1348.0; T.W.L. = 1282.0
Sections 2-2 and 3-3; H.W.L. = 1347.0
Ice @ Elev. 1346.0; T.W.L. = 1282.0

CASE III Horizontal Earthquake Acceleration
Under Normal Operating Water Levels
Water Levels as for CASE I

CASE IV Standard Project Flood Water Levels
H.W.L. - 1350.65; T.W.L. - 1297.5

Note: Uplift loadings were applied to structures for CASE I through CASE IV in accordance with assumptions detailed on Plate III.

CONSTRUCTED OSWEGATCHIE RIVER PROJECT
BROWNS FALLS DEVELOPMENT
VALUES AND ASSUMPTIONS
STABILITY ANALYSIS
CONCRETE SECTIONS

1. Nomenclature

ΣH = Summation of horizontal forces
ΣV = Summation of vertical forces
ΣMr = Summation of resisting moments
ΣMo = Summation of overturning moments

Factor of Safety Against Overturning $= \frac{\Sigma Mr}{\Sigma Mo}$

Coefficient of Sliding $= \frac{\Sigma H}{\Sigma V}$

2. Unit Weights

Unit Weight of Concrete = 145 lbs/cu. ft.
Unit Weight of Water = 62.4 lbs/cu. ft.

3. Uplift - for all cases considered, the pressure was assumed to vary linearly from full headwater pressure at the upstream side to tailwater pressure or zero pressure at the downstream side taken over 100% of the base area.

4. Sliding (Shear Included)

$$Ssf = \frac{f\Sigma V + rSaA}{\Sigma H}$$

Ssf = Shear Friction Factor of Safety
f = 0.75 r = 0.5 Sa = 380 psi

5. Ice - An ice loading of 5 kip/ft. was applied to 1.0 foot below the headwater level.

6. Earthquake - Seismic coefficient taken as 0.05 applied in a horizontal direction. The increase in water pressure, total horizontal force, and overturning moment caused by the earthquake loading was determined from data presented in "Design of Small Dams", USBR, pages 236-238.

STABILITY SUMMARY

SECTION	CONDITION	BASE ELEV.	BASE LENGTH	ΣH (KIPS)	ΣV (KIPS)	ΣH/ΣV	S_{s-f}	RESULTANT FROM DOWNSTREAM	ΣM_R (K-FT)	ΣM_O (K-FT)	$\Sigma M_R / \Sigma M_O$	BASE STRESS (PSI) UPSTREAM	BASE STRESS (PSI) DOWNSTREAM
NON-OVERFLOW SECTION (SECTION 1-1)	CASE I	1300.0	35.1	75	97	0.77	13.8	10.9	3,547	2,481	1.4	- 3	41
	CASE II	1300.0	35.1	80	97	0.82	12.9	8.5	3,547	2,721	1.3	-11	49
	CASE III	1300.0	35.1	87	97	0.89	11.9	9.4	3,547	2,632	1.3	- 8	46
	CASE IV	1300.0	35.1	80	96	0.84	12.9	9.4	3,547	2,650	1.3	- 8	46
SPILLWAY (SECTION 2-2)	CASE I	1286.0	54.0	124	169	0.73	13.0	18.2	9,493	6,420	1.5	0.5	43
	CASE II	1286.0	54.0	121	171	0.71	13.3	9.6	9,440	6,360	1.5	0	44
	CASE III	1286.0	54.0	143	169	0.85	11.2	15.5	9,493	6,882	1.4	- 6	49
	CASE IV	1286.0	54.0	130	147	0.88	12.2	16.6	9,493	7,049	1.4	- 3	41
SPILLWAY (SECTION 3-3)	CASE I	1279.0	56.75	153	221	0.69	11.2	17.5	12,219	8,356	1.5	- 4	58
	CASE II	1279.0	56.75	149	223	0.67	11.5	17.5	12,165	8,261	1.5	- 4	59
	CASE III	1279.0	56.75	178	221	0.81	9.7	14.5	12,219	9,015	1.4	-13	67
	CASE IV	1279.0	56.75	160	192	0.84	10.6	15.6	12,262	9,235	1.3	- 8	55
SLUICE BLOCK (SECTION 4-4)	CASE I	1298.0	43.0	933	1,478	0.63	15.7	16.3	62,481	38,360	1.6	6	36
	CASE II	1298.0	43.0	991	1,478	0.67	14.8	14.4	62,481	41,235	1.5	0.2	41
	CASE III	1298.0	43.0	1,096	1,478	0.74	13.3	13.9	62,481	41,946	1.5	- 1	43
	CASE IV	1298.0	43.0	995	1,452	0.69	14.7	15.0	62,481	40,734	1.5	2	39
INTAKE SECTION (SECTION 5-5)	CASE I	1308.0	53.0	1,625	3,658	0.44	32.4	16.0	154,921	96,617	1.6	- 3	34
	CASE II	1308.0	53.0	1,781	3,658	0.49	26.8	14.2	154,921	102,817	1.5	- 6	37
	CASE III	1308.0	53.0	1,940	3,658	0.53	24.6	14.3	154,921	102,487	1.5	- 6	37
	CASE IV	1308.0	53.0	1,759	3,654	0.48	27.1	15.3	158,135	102,355	1.5	- 4	35

NIAGARA MOHAWK POWER CORPORATION
Syracuse, New York

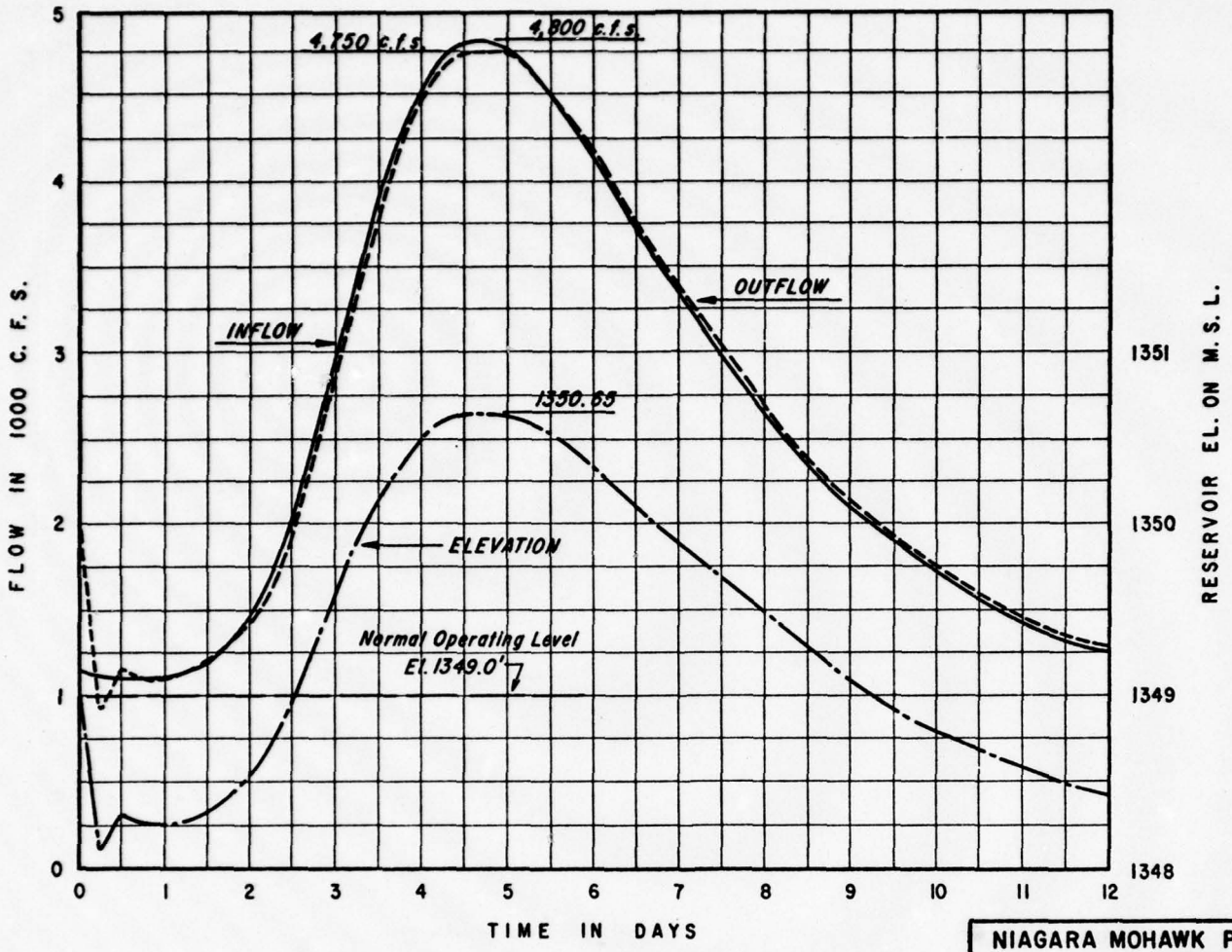
CONSTRUCTED OSWEGATCHIE RIVER PROJECT
BROWNS FALLS DEVELOPMENT
FPC PROJECT NO. 2713

CONCRETE STABILITY SUMMARY

UHL, HALL & RICH
BOSTON MASSACHUSETTS — CHARLOTTE NORTH CAROLINA

DATE: JULY 1972
CLIENT 2225 JOB 301

PLATE I



NOTES:

1. *SPF taken as 60% of PMF + Base Flow*
2. *Drainage Area at Project is 178 sq. miles.*

NIAGARA MOHAWK POWER CORPORATION
SYRACUSE N.Y.
CONSTRUCTED OSWEGATCHIE RIVER PROJECT
BROWNS FALLS DEVELOPMENT
F. P. C. PROJECT NO. 2713

HYDROGRAPHS
STANDARD PROJECT FLOOD ROUTING

UHL, HALL & RICH
Division of Chas. T. Main of New York

SCALE:
DATE: MAY, 1972
CLIENT JOB
2225 - 301

PLATE V

EXHIBIT "I"

Stream flow records, as given in the U.S.G.S. Water Supply Papers and the Surface Water Records of New York for the gaging station below Cranberry Lake Dam, the gaging station near Oswegatchie, New York and the gaging station near Heuvelton, New York were used in computing the monthly mean regulated flows of the Oswegatchie River at the four constructed developments. For the period October 1924 through September 1968, the difference in flow between the Oswegatchie gaging station drainage area = 263 square miles, and the Cranberry Lake gaging station, drainage area = 144 square miles, was used to compute by drainage area ratio the increment of natural flow to add to the Cranberry Lake flow to obtain the regulated flows at the Browns Falls, Flat Rock and South Edwards developments. For the same period, the difference in flow between the Heuvelton gaging station, drainage area = 973 square miles, and the Cranberry Lake gaging station, drainage area = 144 square miles, was used to compute by drainage area ratio the increment of natural flow to add to the Cranberry Lake flow to obtain the regulated flow at the Eel Weir Development.

Curve Sheets 1, 2, 3 and 4 show the flow duration curves of the monthly mean regulated flows at Browns Falls, drainage area = 178 square miles, Flat Rock, drainage area = 262 square miles, South Edwards, drainage area = 277 square miles and Eel Weir, drainage area = 1590 square miles, respectively.

Flashboards are used on the Browns Falls and South Edwards spillways. At Browns Falls the 2 feet high boards are left in place throughout the year unless removed by ice or high water. After the high water subsides, the lost flashboards are replaced. At South Edwards the 2 feet high flashboards

are removed around October 15 and replaced about May 31 every year. No flashboards are used at either the Flat Rock or Eel Weir developments.

The headwater ponds at Browns Falls and South Edwards are normally kept at the top of the flashboards or slightly below and at the spillway crest at Eel Weir which has no boards. At Flat Rock the headwater pond is normally maintained at one foot below the spillway crest. The Browns Falls pond normally utilizes up to 10 feet of drawdown to control the low average daily flows for efficient operation of its units, while the other three ponds are normally used for very short periods of regulation with only sufficient pondage used to meet the peak demands of the Applicant's system.

The annual peak load of the Applicant's system occurs in December which, during periods of low runoff, is the critical period for power supply. The 90 percent of time flow for December, therefore, has been taken as a measure of the dependable capacity of the project. The following table shows the December 90 percent time flow, the number of weekday hours in the peak and the corresponding capacity for each of the four developments in the project:

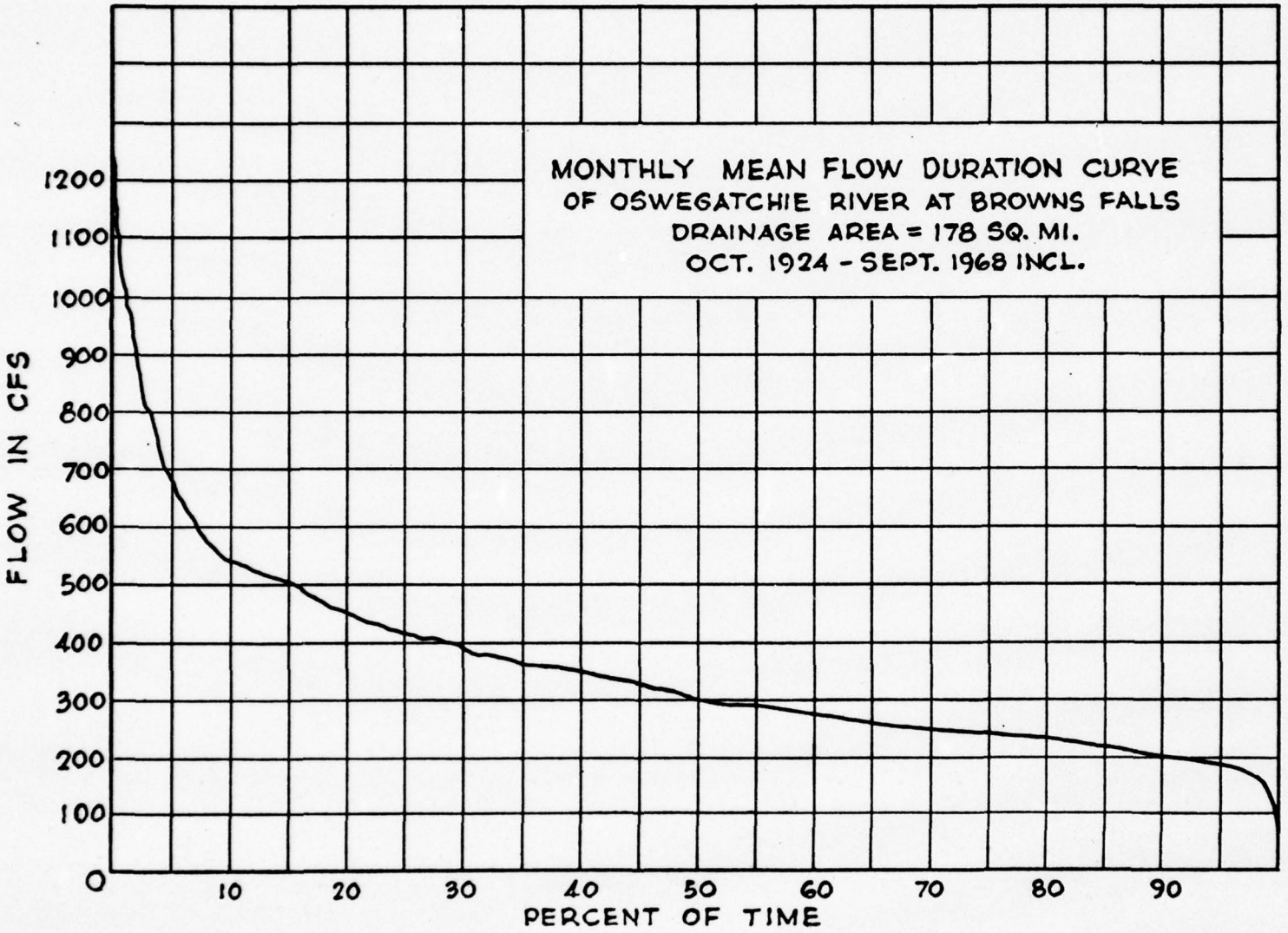
Development	December 90% Time Flow cfs	Approx. No. of Hours in Peak	Power Output Kw
Browns Falls	174	4.3	16,200
Flat Rock	296	5.2	5,620
South Edwards	316	10.9	3,120
Eel Weir	1,454	11.8	2,470

The average annual output in kilowatthours at each of the developments is estimated as follows:

Development	Annual Energy Kwhrs
Browns Falls	53,030,000
Flat Rock	17,680,000
South Edwards	19,570,000
Eel Weir	11,607,000

Curve Sheet No. 5 shows the estimated tailwater rating curves at Browns Falls, Flat Rock and South Edwards. Curve Sheet No. 6 shows a similar rating curve for Eel Weir. On these curves the expected tailwater levels are plotted against total flow in cubic feet per second. Curve Sheet No. 7 shows the curves of estimated plant capability in kilowatts plotted against gross head in feet for all four developments.

The power generated by this project helps to meet the demands of the industrial, commercial, residential and farm customers of the Niagara Mohawk System. The Applicant has no plans for further development at this project in the immediate future.



CURVE SHEET No. 1

8/29/79

MR NEAL DUNLEVY, P.E.
STETSON - DALE ENGINEERS
BANKERS TRUST BUILDING
UTICA, N.Y. 13501

DEAR NEAL:

ENCLOSED IS THE H&H APPENDIX TO THE PHASE I REPORT FOR CRANBERRY LAKE DAM, NY-397.

THE ASSESSMENT RATED THE SPILLWAY AS SERIOUSLY INADEQUATE, CAPABLE OF PASSING ONLY 18% OF THE PMF WITHOUT OVERTOPPING THE NON-OVERFLOW SECTIONS.

SINCERELY,

Walter Lynick P.E.
DAM SAFETY SECTION

O'BRIEN&GERE ENGINEERS

SUBJECT	SHEET	BY	DATE	JOB NO
CRANBERRY LAKE DAM	4	RE		

Checked DBC

STAGE - DISCHARGE

- ASSUME SLUICE GATES open (fully)

SLUICE GATES (2) - INV ELEVATION - 1472.2

- GATE SIZE - WIDTH = 5'

HEIGHT = 4'

ASSUME OUTLET CONTROL — W.S.E @ 1478 (avg for PMF condition)

uniform passage through gate house

Head losses - ENTRANCE LOSS = .5

RACK LOSS = .15

$n = .012$

$L \approx 15'$

$r = \frac{20}{18} = 1.11$

$$H = \left(1 + Ke + Kr + \frac{29n^2L}{r^{133}}\right)\frac{V^2}{2g} = (1.65 + .05)\frac{V^2}{2g}$$

$$H = (1.7)\frac{V^2}{2g}$$

$$V \approx \sqrt{38\,H}$$

STAGE - DISCHARGE (Cont)

- Assume Stoplog gates and log sluice to be closed and ineffective in passing flows

- Spillway Capacity

Spillway Crest elev = 1490.0'
Crest length = 110.0'
Weir Coeff = 3.0

$$Q = CLH^{3/2} = 330H^{3/2}$$

- Above Elevation 1493.5 assume an additional Overflow Length ≈ 100 feet C = 2.6

$$Q = CLH^{3/2} = 494\ H^{3/2} \quad \text{use} \quad 500\ H^{3/2}$$

O'BRIEN & GERE ENGINEERS

SUBJECT	SHEET	BY	DATE	JOB NO
CRANBERRY LAKE DAM			6/22/77	

Checked DBC

STAGE - DISCHARGE RATING

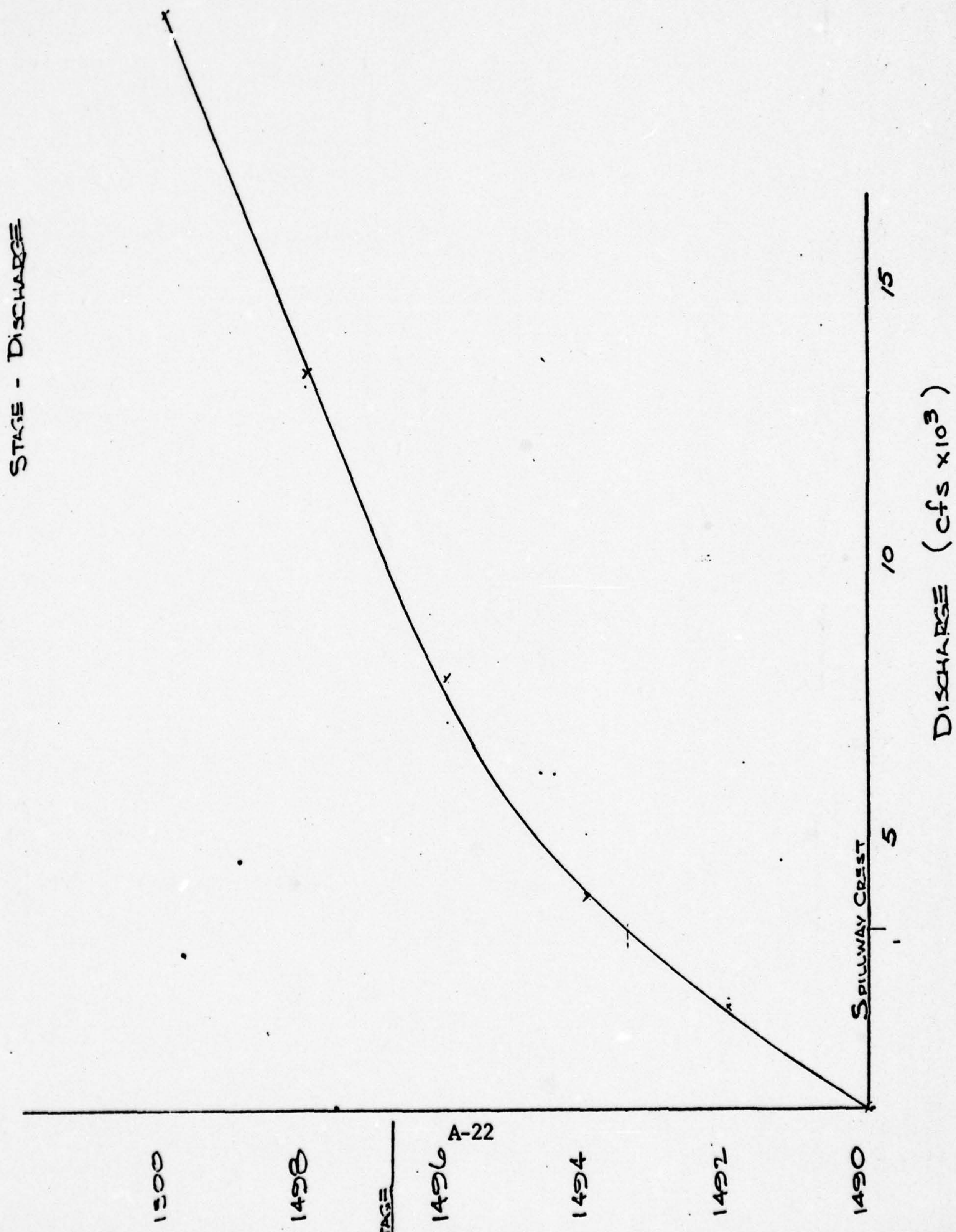
Elev	(ft) Hgates	(ft) Hspillway	(ft) Hoverflow	(cfs) Qg	(cfs) Qs	(cfs) Qo	(cfs) Q Total
1490	Assumed closed @ start of PMF	0	0	0	0	0	Say 0
1492	14	2	0	923	933	0	1856
1494	16	4	.5	986	2640	177	3803
1496	18	6	2.5	1046	4850	1976	7872
1498	20	8	4.5	1102	7467	4773	13342
1500	22	10	6.5	1157	10436	8286	19879
1502	24	12	8.5	1208	13718	12391	27317

Division of O'Brien & Gere Engineers, Inc.
PHILADELPHIA, PA

SHEET NO. ______ OF ______
DATE 6/20/78

NAME OF CLIENT NYSDEC
COMP. BY REH

PROJECT CRANBERRY LAKE DAM
CHECKED BY DBC



O'BRIEN & GERE ENGINEERS

SUBJECT	SHEET	BY	DATE	JOB NO
CRANBERRY LAKE DAM	7	P.E.K.	6/22/78	

Checked DBC

STAGE - STORAGE

Surface area at Spillway crest = 7104 Ac (from USGS sheet 1:625,000 Scale)

Storage at Spillway crest = 57400 Ac-Ft (from NYSDEC)

Approx lake depth = $\frac{7104+0}{2}$ $d = 57400$ $d = 16.2'$

Assume Area varies w/ depth $7104/16.2 = 438.5$ Ac/Ft

Above Spillway Crest - @ 1490 Area = 7104 Ac, @ 1500 Area = 11264 Ac

$\therefore A = 416\,d$, Storage $= 208\,d^2 + 7104d$

	Stage	Area (Ac)	INC Storage (Ac-Ft)	Accum Stor (Ac-Ft)	
	1473.8	0	0	0	
	1478.0	1841.8	3867.8	3867.8	
	1482.0	3595.8	10875.2	14743.0	
	1486.0	5349.9	17891.4	32634.4	
	1490.0	7104.0	24907.8	57542.2	AccStor
Above Spillway Elev.	1490	7104.0		57400	0
	1492	7936.0		72582	15040
	1494	8768.0		89286	31744
	1496	9600.0		107654	50112
	1498	10432.0		127686	70144
	1500	11264.0		149382	91840
	1502	12096.0		172742	115200

Planimeter check w/ USGS 1:625,000 series - Lake Area @ El 1500

$= 1.1(16) \times \frac{5280^2}{43560} = 11{,}264$ Ac

Division of O'Brien & Gere Engineers, Inc.
PHILADELPHIA, PA

SHEET NO. 10 OF

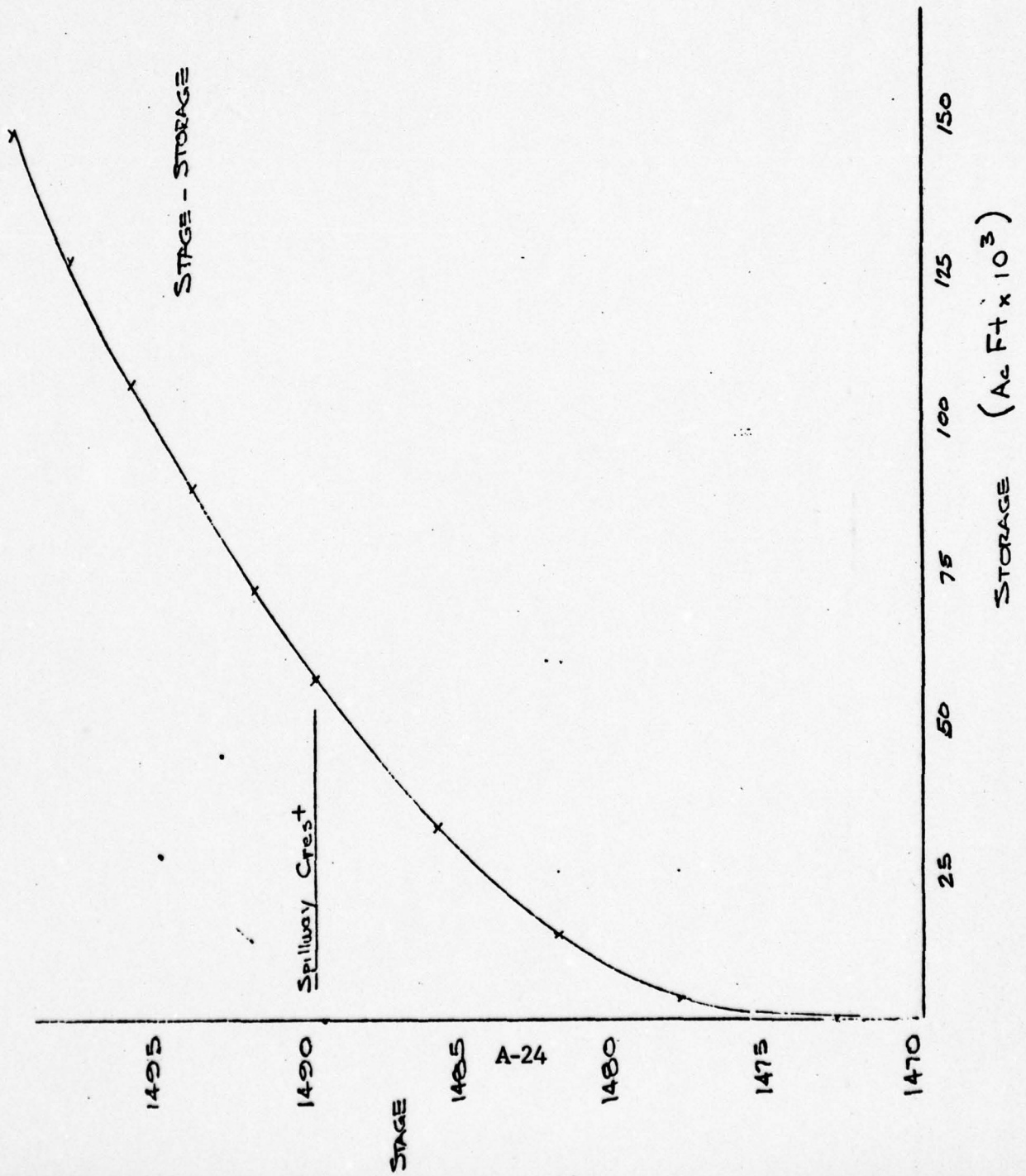
DATE 6/29/78

NAME OF CLIENT NYSDEC

COMP. BY REH

PROJECT CRANBERRY LAKE DAM

CHECKED BY DBC



Division of O'Brien & Gere Engineers, Inc.
PHILADELPHIA, PA

SHEET NO. ____ OF ____

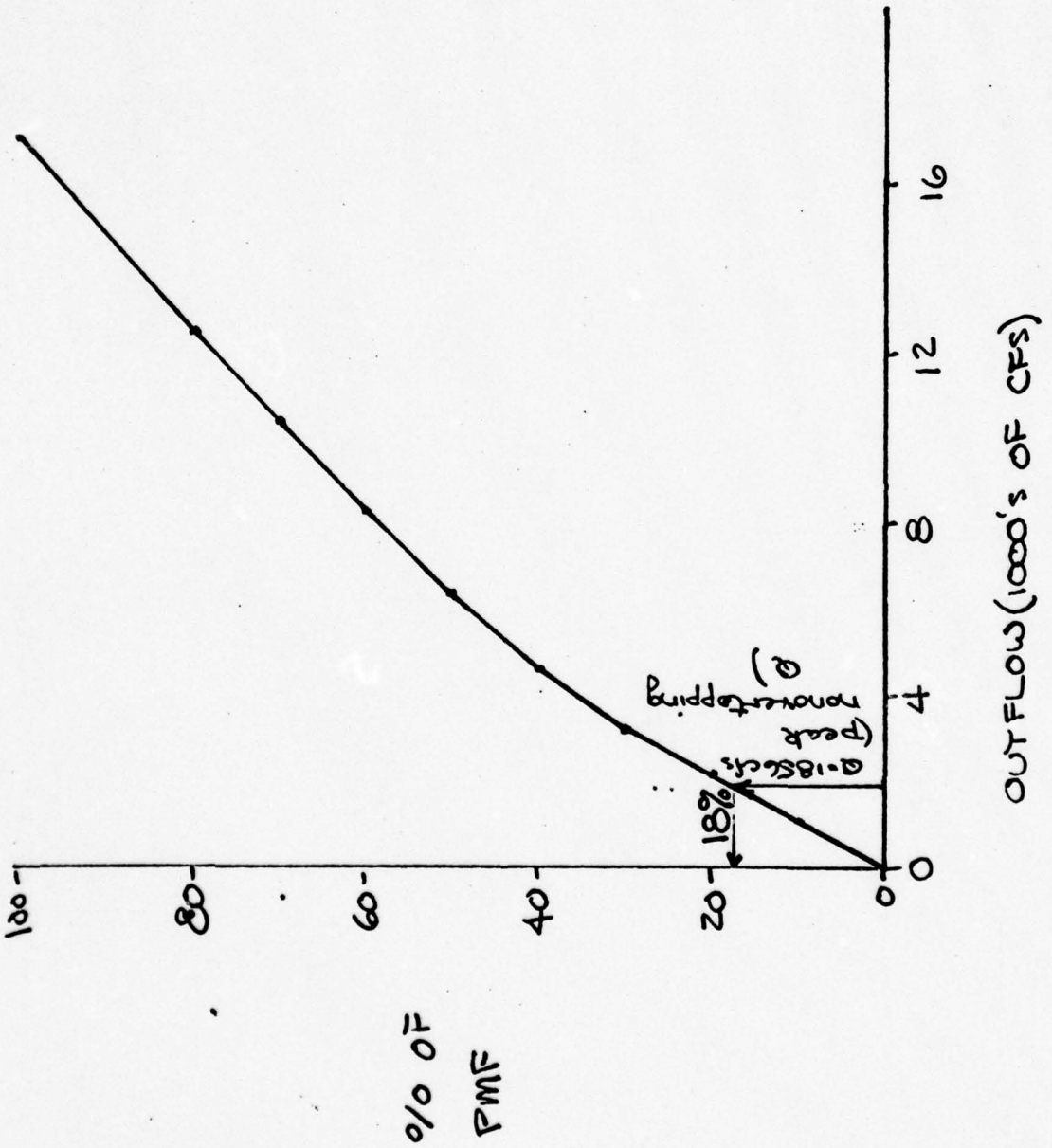
NAME OF CLIENT NYSDEC

DATE 8/27/78

PROJECT Cranberry Lake

COMP. BY DBC

CHECKED BY REH



```
**********
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01
**********

                                    PMF ROUTING
                                CRANBERRY LAKE DAM
                          O'BRIEN + GEPE + JUSTIN + COURTNEY DIV

                                  JOB SPECIFICATION
      NO   NHR  NMIN  IDAY   IHR  IMIN METRO  IPLT  IPRT NSTAN
      48     2     0     1     0     0     0     0     2     0
                                 JOPER       NWT
                                    5         0

                          MULTI-PLAN ANALYSES TO BE PERFORMED
                                NPLAN= 1 NRTIO= 9 LRTIO= 1
          RTIOS=    .10   .20   .30   .40   .50   .60   .70   .80  1.00

                                SUB-AREA RUNOFF COMPUTATION
      ISTAQ  ICOMP  IECON  ITAPE  JPLT  JPRT  INAME
          1      0      0      0     1     0      0

                                  HYDROGRAPH DATA
      IHYDG  IUHG   TAREA   SNAP  TRSDA  TRSPC  RATIO  ISNOW  ISAME  LOCAL
          0     1  144.00   0.00   0.00   0.00  0.000      0      0      0

                                    PRECIP DATA
                                 MP   STORM    DAJ    DAK
                                  6    0.00   0.00   0.00
                                PRECIP PATTERN
        .80     .80    2.00    8.60    2.70     .80

                                    LOSS DATA
      STRKR  DLTKR  RTIOL  ERAIN  STRKS  RTIOK  STRTL  CNSTL  ALSMX  RTIMP
       0.00   0.00   1.00   0.00   0.00   1.00   0.00    .10   0.00   0.00

                                UNIT HYDROGRAPH DATA
                          TP= 10.00   CP= .63   NTA= 0

                                  RECESSION DATA
                          STRTQ=   0.00   QRCSN=   0.00   RTIOR= 1.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 5.81 AND R= 4.44 INTERVALS

      UNIT HYDROGRAPH 27 END-OF-PERIOD ORDINATES, LAG= 9.94 HOURS, CP= .62 VOL= 1.00
     475.   1722.   3365.   4887.   5788.   5771.   4947.   3946.   3147.   2509.
    2001.   1596.   1273.   1015.    810.    646.    515.    411.    327.    261.
     208.    166.    132.    106.     84.     67.     54.

                                  END-OF-PERIOD FLOW
                          TIME   RAIN   EXCS    COMP Q
                          1 2 0   .80    .60      285.
```

1	14	0	0.00	0.00	67346.
1	16	0	0.00	0.00	79577.
1	18	0	0.00	0.00	79037.
1	20	0	0.00	0.00	69953.
1	22	0	0.00	0.00	57344.
2	0	0	0.00	0.00	45939.
2	2	0	0.00	0.00	36636.
2	4	0	0.00	0.00	29218.
2	6	0	0.00	0.00	23301.
2	8	0	0.00	0.00	18583.
2	10	0	0.00	0.00	14820.
2	12	0	0.00	0.00	11819.
2	14	0	0.00	0.00	9425.
2	16	0	0.00	0.00	7517.
2	18	0	0.00	0.00	5995.
2	20	0	0.00	0.00	4781.
2	22	0	0.00	0.00	3813.
3	0	0	0.00	0.00	3041.
3	2	0	0.00	0.00	2425.
3	4	0	0.00	0.00	1934.
3	6	0	0.00	0.00	1542.
3	8	0	0.00	0.00	1204.
3	10	0	0.00	0.00	935.
3	12	0	0.00	0.00	669.
3	14	0	0.00	0.00	174.
3	16	0	0.00	0.00	32.
3	18	0	0.00	0.00	0.
3	20	0	0.00	0.00	0.
3	22	0	0.00	0.00	0.
4	0	0	0.00	0.00	0.
4	2	0	0.00	0.00	0.
4	4	0	0.00	0.00	0.
4	6	0	0.00	0.00	0.
4	8	0	0.00	0.00	0.
4	10	0	0.00	0.00	0.
4	12	0	0.00	0.00	0.
4	14	0	0.00	0.00	0.
4	16	0	0.00	0.00	0.
4	18	0	0.00	0.00	0.
4	20	0	0.00	0.00	0.
4	22	0	0.00	0.00	0.
5	0	0	0.00	0.00	0.
		SUM	15.70	14.50	670323.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	79037.	75856.	48554.	18620.	670320.
INCHES		4.90	12.55	14.43	14.43
AC-FT		37634.	96354.	110854.	110854.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

29.	132.	391.	1204.	2812.	4859.	6735.	7958.	7904.	6995.
5734.	4594.	3664.	2922.	2330.	1858.	1482.	1182.	943.	752.
599.	478.	381.	304.	242.	193.	154.	120.	93.	67.
17.	3.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	7904.	7546.	4855.	1862.	67032.
INCHES		.49	1.25	1.44	1.44
AC-FT		3763.	9635.	11085.	11085.

35.	6.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	15807.	15171.	9711.	3724.	134064.
INCHES		.98	2.51	2.89	2.89
AC-FT		7527.	19271.	22171.	22171.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3

95.	396.	1172.	3613.	8436.	14577.	20204.	23573.	23711.	20986.
17203.	13782.	10991.	9765.	6990.	5575.	4446.	3546.	2828.	2255.
1798.	1434.	1144.	912.	727.	580.	463.	369.	280.	201.
52.	10.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	23711.	22757.	14566.	5586.	201096.
INCHES		1.47	3.76	4.33	4.33
AC-FT		11290.	28906.	33256.	33256.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

114.	527.	1563.	4817.	11247.	19436.	26938.	31431.	31615.	27981.
22937.	18376.	14655.	11687.	9320.	7433.	5928.	4727.	3770.	3007.
2398.	1912.	1525.	1216.	970.	774.	617.	482.	374.	267.
70.	13.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	31615.	30342.	19421.	7449.	268128.
INCHES		1.96	5.02	5.77	5.77
AC-FT		15054.	38542.	44342.	44342.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 5

143.	659.	1954.	6021.	14059.	24295.	33673.	39289.	39518.	34977.
28672.	22969.	18318.	14609.	11651.	9291.	7410.	5909.	4713.	3758.
2997.	2390.	1906.	1520.	1212.	967.	771.	602.	467.	334.
87.	16.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	39518.	37923.	24277.	9310.	335160.
INCHES		2.45	6.27	7.22	7.22
AC-FT		18817.	48177.	55427.	55427.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 6

171.	791.	2345.	7225.	16871.	29154.	40408.	47146.	47422.	41972.
34406.	27563.	21982.	17531.	13981.	11150.	8892.	7091.	5655.	4510.
3597.	2868.	2288.	1824.	1455.	1160.	925.	723.	561.	401.
105.	19.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	47422.	45513.	29132.	11172.	402192.
INCHES		2.94	7.53	8.66	8.66
AC-FT		22580.	57813.	66512.	66512.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 7

200.	923.	2735.	8430.	19683.	34013.	47142.	55004.	55326.	48967.
40141.	32157.	25645.	20452.	16311.	13008.	10374.	8273.	6598.	5262.
4195.	3347.	2669.	2128.	1697.	1354.	1080.	843.	654.	468.
122.	23.	0.	0.	0.	0.	0.	0.	0.	0.

AC-FT			26344.	67448.	77598.		77598.		

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 9

229.	1858.	3126.	3634.	22495.	38872.	53877.	62852.	63230.	55963.
45675.	36751.	29309.	23374.	18641.	14866.	11836.	9455.	7540.	6011.
4796.	3825.	3058.	2432.	1940.	1547.	1234.	963.	748.	535.
133.	26.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	63230.	60685.	38847.	14895.	536256.
INCHES		3.92	10.04	11.55	11.55
AC-FT		33107.	77083.	88683.	88683.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 9

245.	1319.	3908.	12842.	28119.	48590.	67346.	78577.	79837.	69953.
57344.	45939.	36636.	29218.	23301.	18583.	14820.	11819.	9425.	7517.
5995.	4791.	3813.	3041.	2425.	1934.	1542.	1204.	935.	669.
174.	32.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	79037.	75856.	48554.	18620.	670320.
INCHES		4.90	12.55	14.43	14.43
AC-FT		37634.	96354.	110854.	110854.

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HYDROGRAPH ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
2	1	0	0	0	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IPES	ISAME
0.0	0.000	0.00	1	1

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.000	0.000	0.000	-1.

STORAGE=	0.	15040.	31744.	50112.	70144.	91840.	115200.	140224.	0.	0.
OUTFLOW=	0.	1856.	3803.	7872.	13342.	19879.	27317.	35555.	0.	0.

STATION 2, PLAN 1, RTIO 1

29.	30.	34.	50.	89.	165.	279.	420.	571.	710.
824.	912.	977.	1023.	1056.	1077.	1089.	1094.	1093.	1088.
1080.	1069.	1056.	1041.	1026.	1010.	993.	975.	958.	940.
922.	904.	885.	868.	850.	833.	816.	800.	783.	768.
752.	737.	722.	707.	693.	679.	665.	652.		

STOR

231.	233.	277.	402.	723.	1336.	2257.	3405.	4626.	5752.
6677.	7387.	7913.	8292.	8555.	8724.	8822.	8861.	8856.	8816.
8749.	8660.	8556.	8439.	8313.	8181.	8044.	7904.	7762.	7619.
7472.	7322.	7175.	7030.	6888.	6749.	6613.	6479.	6348.	6220.
6095.	5972.	5851.	5733.	5617.	5504.	5393.	5284.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1094.	1092.	1066.	920.	36789.
INCHES		.07	.28	.71	.79
AC-FT		542.	2116.	5479.	6084.

848.	1811.	1774.	1738.	1703.	1669.	1635.	1602.	1570.	1538.
1507.	1477.	1447.	1418.	1389.	1361.	1333.	1307.		

STOR

462.	473.	555.	804.	1445.	2671.	4514.	6811.	9252.	11503.
13354.	14774.	15827.	16586.	17113.	17455.	17652.	17734.	17727.	17649.
17517.	17342.	17135.	16903.	16653.	16390.	16117.	15838.	15554.	15267.
14972.	14673.	14378.	14087.	13803.	13524.	13251.	12983.	12721.	12464.
12213.	11966.	11725.	11488.	11256.	11029.	10806.	10588.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2170.	2167.	2118.	1837.	73456.
INCHES		.14	.55	1.42	1.58
AC-FT		1075.	4203.	10935.	12148.

STATION 2, PLAN 1, RTIO 3

86.	89.	103.	149.	268.	494.	836.	1261.	1713.	2114.
2438.	2647.	2872.	3006.	3099.	3160.	3195.	3210.	3210.	3197.
3175.	3145.	3110.	3070.	3027.	2982.	2935.	2887.	2838.	2788.
2737.	2686.	2635.	2584.	2535.	2487.	2439.	2393.	2347.	2302.
2259.	2215.	2173.	2131.	2091.	2051.	2012.	1973.		

STOR

693.	714.	832.	1207.	2168.	4007.	6771.	10215.	13878.	17256.
20036.	22173.	23761.	24908.	25705.	26226.	26529.	26660.	26656.	26547.
26355.	26100.	25796.	25455.	25087.	24699.	24296.	23883.	23463.	23037.
22602.	22159.	21720.	21284.	20865.	20450.	20043.	19644.	19252.	18868.
18491.	18121.	17759.	17403.	17054.	16712.	16376.	16047.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3210.	3206.	3134.	2727.	109192.
INCHES		.21	.81	2.11	2.35
AC-FT		1591.	6219.	16233.	18058.

STATION 2, PLAN 1, RTIO 4

114.	118.	137.	199.	357.	659.	1114.	1681.	2260.	2785.
3218.	3551.	3798.	4131.	4360.	4505.	4583.	4610.	4597.	4553.
4487.	4403.	4306.	4201.	4089.	3973.	3856.	3768.	3704.	3639.
3573.	3506.	3439.	3373.	3309.	3246.	3184.	3123.	3064.	3005.
2948.	2892.	2836.	2782.	2729.	2677.	2626.	2576.		

STOR

924.	959.	1109.	1609.	2991.	5343.	9029.	13621.	18506.	23014.
26726.	29581.	31704.	33225.	34260.	34912.	35265.	35386.	35327.	35131.
34831.	34452.	34016.	33540.	33035.	32513.	31991.	31442.	30895.	30341.
29773.	29195.	28622.	28059.	27507.	26965.	26433.	25912.	25401.	24899.
24407.	23925.	23451.	22987.	22531.	22085.	21646.	21216.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4610.	4596.	4402.	3670.	146646.
INCHES		.30	1.14	2.95	3.16
AC-FT		2280.	8736.	21851.	24252.

STATION 2, PLAN 1, RTIO 5

143.	148.	171.	248.	446.	824.	1393.	2088.	2800.	3457.
4171.	4950.	5514.	5908.	6167.	6322.	6395.	6405.	6365.	6289.
6184.	6059.	5918.	5767.	5609.	5446.	5281.	5116.	4952.	4788.
4623.	4459.	4299.	4144.	3995.	3852.	3715.	3584.	3613.	3544.
3477.	3410.	3345.	3282.	3219.	3157.	3097.	3038.		

STOR

1155.	1197.	1387.	2011.	3613.	6678.	11286.	17024.	23137.	28777.

		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
	CFS	6405.	6388.	6116.	4827.	191316.
	INCHES		.41	1.54	3.74	4.12
	AC-FT		3169.	12136.	28736.	31639.

STATION 2, PLAN 1, RTIO 6

171.	177.	205.	298.	535.	989.	1671.	2485.	3340.	4417.
5631.	6541.	7199.	7650.	7957.	8161.	8243.	8232.	8150.	8014.
7846.	7680.	7496.	7301.	7097.	6889.	6679.	6468.	6259.	6051.
5842.	5635.	5432.	5237.	5049.	4867.	4692.	4523.	4361.	4204.
4053.	3907.	3784.	3711.	3641.	3571.	3503.	3436.		

STOR

1396.	1437.	1664.	2413.	4336.	8014.	13543.	20435.	27769.	34516.
39998.	44113.	47072.	49111.	50425.	51170.	51470.	51430.	51129.	50634.
49993.	49244.	48416.	47533.	46614.	45674.	44725.	43775.	42829.	41891.
40950.	40012.	39099.	38217.	37367.	36548.	35758.	34996.	34262.	33554.
32872.	32214.	31578.	30959.	30351.	29755.	29170.	28597.		

		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
	CFS	8243.	8212.	7827.	6081.	239283.
	INCHES		.53	2.02	4.71	5.15
	AC-FT		4074.	15533.	36201.	39571.

STATION 2, PLAN 1, RTIO 7

200.	207.	240.	347.	624.	1154.	1945.	2882.	3948.	5681.
7079.	8181.	9096.	9712.	10094.	10296.	10357.	10312.	10185.	9997.
9764.	9500.	9213.	8913.	8604.	8291.	7979.	7707.	7457.	7209.
6960.	6712.	6471.	6239.	6014.	5798.	5590.	5389.	5195.	5008.
4828.	4654.	4487.	4326.	4170.	4020.	3876.	3768.		

STOR

1617.	1676.	1941.	2816.	5059.	9349.	15800.	23843.	32397.	40221.
46530.	51244.	54594.	56849.	58250.	58988.	59214.	59047.	58582.	57894.
57042.	56074.	55024.	53923.	52791.	51647.	50504.	49366.	48237.	47118.
45995.	44877.	43790.	42739.	41727.	40750.	39809.	38902.	38027.	37184.
36371.	35587.	34832.	34104.	33401.	32725.	32072.	31440.		

		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
	CFS	10357.	10322.	9787.	7430.	290676.
	INCHES		.67	2.53	5.76	6.26
	AC-FT		5121.	19421.	44232.	48070.

STATION 2, PLAN 1, RTIO 8

228.	236.	274.	397.	713.	1319.	2208.	3280.	4966.	6930.
8557.	10099.	11111.	11783.	12190.	12392.	12434.	12356.	12186.	11947.
11658.	11334.	10985.	10621.	10249.	9874.	9499.	9128.	8763.	8405.
8049.	7730.	7452.	7184.	6926.	6677.	6437.	6205.	5982.	5767.
5560.	5360.	5167.	4981.	4802.	4629.	4463.	4302.		

STOR

1848.	1915.	2219.	3218.	5781.	10685.	18059.	27253.	36992.	45860.
52988.	58267.	61973.	64435.	65926.	66664.	66820.	66533.	65909.	65035.
63977.	62790.	61513.	60181.	58817.	57442.	56071.	54713.	53376.	52063.
50759.	49469.	48216.	47007.	45841.	44716.	43633.	42588.	41581.	40610.
39674.	38771.	37901.	37062.	36254.	35474.	34723.	33999.		

		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
	CFS	12434.	12394.	11750.	8807.	343895.
	INCHES		.80	3.04	6.83	7.41
	AC-FT		6149.	23317.	52431.	56871.

5534.	15041.	14519.	13990.	13434.	12928.	12435.	11946.	11466.	10996.
10529.	10069.	9625.	9200.	8794.	8406.	8035.	7716.	7438.	7171.
6913.	6664.	6425.	6194.	5971.	5756.	5549.	5350.		

STOP

2319.	2394.	2773.	4022.	7227.	13356.	22576.	34053.	46144.	57078.
65791.	72159.	76558.	79415.	81047.	81743.	81721.	81155.	80181.	78908.
77420.	75784.	74051.	72262.	70448.	68630.	66821.	65033.	63275.	61551.
59862.	58156.	56532.	54976.	53489.	52067.	50708.	49407.	48154.	46947.
45783.	44661.	43579.	42536.	41531.	40562.	39627.	38727.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	16837.	16776.	15816.	11640.	452673.
INCHES		1.08	4.09	9.02	9.75
AC-FT		9323.	31387.	69298.	74861.

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PEAK FLOW SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS

OPERATION	STATION	PLAN	RATIOS APPLIED TO FLOWS .10	.20	.30	.40	.50	.60	.70	.80	1.00
HYDROGRAPH AT	1	1	7904.	15807.	23711.	31615.	39518.	47422.	55326.	63230.	79037.
		2	0.	0.	0.	0.	0.	0.	0.	0.	0.
ROUTED TO	2	1	1094.	2170.	3210.	4610.	6405.	8243.	10357.	12434.	16837.
		2	0.	0.	0.	0.	0.	0.	0.	0.	0.

REPORT WITH APPLICATION

DAM ON OSWEGATCHIE RIVER
AT BROWNS FALLS
TOWN OF CLIFTON, ST. LAWRENCE CO., N.Y.

NORTHERN NEW YORK UTILITIES, INC.

James P. Brownell
M. Am. Soc. C.E.
Civil and Hydraulic Engineer
Carthage, New York

May 26, 1922.

Frank M. Williams
State Engineer
Albany, N.Y.

Dear Sir:-

Enclosed find application for the Northern New York Utilities, Inc. for permission to build a concrete dam at Browns Falls, N.Y., across the Oswegatchie River, and under another cover we are mailing you the plans.

The site for this dam is about one mile easterly of the bridge across said river at the place marked on the Geological Sheet as Browns Falls Plant.

At this site, some years ago, was constructed a concrete dam for the purpose of reducing the trouble caused by anchor ice to the old plant located at the bridge. This dam was also constructed with the idea of being raised at some future time, when a new plant to utilize all the available head might be constructed. In the construction of this concrete dam the down stream face was left in steps, 3 feet in height and 2 feet in width, with plum stones protruding for binding purposes. Also in the crest of the dam, grooves were left for binding the old work with any future work.

This dam has been in place some ten years and shows that, excepting some slight frozen surface concrete and which is

to be removed, the concrete is of good quality and that there is no leakage between the rock foundation and the concrete.

It is now proposed to build a new dam over and upon the old dam, more for the purpose of securing the best location for the new dam, rather than to secure the benefits of any portion of the old work.

The proposed dam will create a pond flowing back to the tail water of the Newton Falls Paper Co. From the dam will be constructed a pipe line, part of wood and part of steel, 6200 feet in length, to a power house to be erected about 2000 feet above the mouth of Little River, so that the whole fall of the river between Newton Falls and the power house, some 267 feet, will be utilized.

The river bed at the dam site is bare granite rock, the surface of which, though comparatively smooth in texture, is very rough in contour. This rock underlies all this territory, On the north end of the dam, this rock was uncovered for some distance under the bank when the old dam was built. The surface of this rock was still rising slightly at the point where it was uncovered last, (at elevation about 1314), but it would appear that further excavation would show a summit soon. At some 1000 feet still farther north, the rock appears as an outcrop at the top of a hill some 30 feet higher than the proposed new spillway of the dam. The intervening portion of the land between the rock as uncovered at the dam site and this outcrop, as disclosed by test pit excavations, one of which was carried down some 18 feet,

shows the overburden to consist of a dense and compact sand of of a greenish cast, much similar to hornblende rock. The excavation was made with difficulty and required picking after the first few feet. The marks of thepick in the sand glistened as if rock had been encountered.

A few stones but no large boulders were encountered, and, with the exception of the first few feet, the same material continued throughout the sinking of the test pit. It was not thought the rock was near, probably not nearer than 1314, as it is quite typical of Adirondack country that boulders are encountered just before the bed rock is found.

From my observation, I do not deem it practical or necessary to follow the bed rock for a foundation to this outcrop or to a point as high as the dam. My impression is that the rock follows unevenly but approximately elevation 1314 until it reaches the high rock which outcrops in the point some 1000 feet northerly.

As shown in our plans it is proposed to follow this bed rock until a point is reached at about under the proposed new shore line, beyond which it is intended to step up on this sand foundation in the nature of a core wall, the depth of which below the original ground surface shall be at least 2.5 times the depth of water which will overlie such ground surface. The bottom of the trench will be filled with concrete, and above will be constructed forms to confine the concrete. Around the whole portion of this dam, or core, or key, will be placed an embankment, more for the purpose of creating a mass of earth

than for the purpose of stability.

The bed of the river from the dam site to the bridge is bare solid rock, and there are also other outcrops of rock in the bed and sides of the stream at different points, especially so where the descent of the river is more rapid. The intervening river bed is earth shingled with boulders, and gives indications that the earth would make a good material to confine the water, if not subjected to high velocities.

On the south side of the river, the overburden of earth between Station 4 and 6 ranges from nothing to five feet, but between Stations 2 and 4, tests made by a well drill show that the depth of earth above the rock runs as high as 13 feet. It is possible that it may exceed this depth at points. Test pits were carried down in several places but the preponderance of boulders prevented reaching rock by hand means. A well drill was secured and five test holes drilled at five ppints which indicated solid rock at from 10 to 13 feet.

The soil in the section between Stations 2 and 4 is a very compact sand loam of a grey color and thick with boulders, and is the same nature of material generally overlying bed rock, About 50 feet below Station 1+90, the bed rock outcrops in a ledge and farther up the hill the rock lies close to the surface. Between Station 0 and 1+90 on the base line, the solid rock can be reached readily with a sounding bar.

Continuing southerly we find the solid rock outcropping again at the top of the mountain, some 2000 feet southwesterly of the dam. There are also several other outcrops of rock near the

flow line in the vicinity.

It is proposed to found the dam entirely upon solid rock, excepting the key into the north bank. It is proposed to found directly upon the rock, with no other preparation than clearing and cleaning. At such portions of the dam site as does not show sufficient roughness to provide safety against sliding, pot holes will be blasted to give roughness. Also 2 inch anchor pins will be placed as an additional factor of safety. It is not proposed to excavate any cut off wall in the rock whatever, neither to do any blasting near the water edge of the dam, as experience has shown us that in this rock, any blasting or loosening of the rock opens up microscopic seams in an otherwise impervious rock, which seams cannot be ever closed again.

Analysis of the stresses show that individually the old portion of the dam would not be strong enough to prevent its overturning against the new portion, and that therefore there will always be a tendency for the old concrete to crowd against the new. Therefore it is not thought possible that any seam can open between the new work and the old, but to obviate any leakage that might occur, it is proposed to create asystem of drains and weepers to take care of any such possible leakage.

Great care is to be taken in uniting the old and new work, and particularly so to take care of shrinkage of new concrete. It is proposed to allow the new work when it has reached the level of the old work, to stand for some time. Then when the work is again started to run the new concrete over the whole of the old work and the concrete just placed, and to imbed therein horizontal bars, $\frac{3}{4}$

inch square, at about 3 feet intervals, such bars to run crosswise of the dam and joint between the old and new, this reinforcement to extend nearly from face to face of dam.

Horizontal construction joints are to have imbedded therein plum stones for keying the work. Vertical joints between different operations will be provided with V shaped grooves as contraction joints.

The prevailing wind being from the west and the pond being of such large dimensions as compared to the flow, and from our experience with other dams, it is not expected that any ice will pass over the dam, but rather that it will rot or be driven against the opposite shores. On the spillway portion, the curved apron is placed more for looks and protection to the toe of the concrete, rather than an injury to the rock foundation.

The rock foundation is impervious to water fully more so than any concrete that can be built. It is possible to place the concrete directly upon clean dry rock. Consequently no allowance for uplift has been considered or provided for. There will be more or less ice pressure to contend with, and the design of section chosen allows for 5 or more tons per lineal foot of dam. The point of maximum ice pressure occurs when the water is at the height of the spillway portion of the dam , and for the bulkhead portion when the water is not over one foot above the spillway. Vertical reinforcement rods are to be placed near the fan of the concrete, to transfer the ice pressure throughout the whole section.

The Oswegatchie river is fairly well regulated by the large reservoir at Cranberry Lake, the largest lake of the Adirondacks, and is to be further regulated by an additional reservoir of about 2 billion cubic feet. The run-off as recorded at Newton Falls, shows that 1890 cubic feet per second is the highest flood recorded. This occured in 1913, a high water year for this section. With 50% added and for a spillway length of 195 feet, this would represent a depth over the crest of 2.53 feet.

The bulkhead portion of the dam has been placed at elevation 1352, and the embankment over the core wall on the north end, at elevation 1356. These elevations are believed to be ample for any location. At this location the prevailing winds are from the northwest and southwest, and no high winds of a direction to blow against the dam have been known. All but the westerly end of the pond is shut in by high hills.

The material of which the dam is to be composed is gravel located in the vicinity. Tests of the sand portion of the gravel, as found near the surface of the pit shows, when mixed with cement in a three to one portion , a tensile strength of about 350 # to the square inch as against about 300 # with Ottawa Sand for 7 days. The 28 days test much better. Colormetric tests of the gravel show very good for Adirondack gravel, and would be allowable.

It is proposed to use the bank run gravel, which is a well graded mixture, and to proportion the cement to the sand portion content. With a mortar of one cement to three of sand, the stone portion will amount to about four and one-half parts. Con-

crete which has been thus proportioned, has been found to give good results, dense and all voids filled. Plum stones will be added. For the crest of the spillway and for reinforced work in the head works, a richer concrete will be used, in which the relative proportion of cement to sand will be in ratio of one to two and one half.

Yours very respectfully,

JPB:BS

James P. Brownell
Engineer

AD-A077 483 NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/13
NATIONAL DAM SAFETY PROGRAM. BROWNS FALLS DAM (INVENTORY NUMBER--ETC(U)
SEP 79 J B STETSON DACW51-79-C-0001

UNCLASSIFIED NL

2 OF 3
ADA 077483

15 (12/75)

New York State Department of Environmental Conservation

MEMORANDUM

391 0502

TO: G. Koch
FROM: S. Zeccolo
SUBJECT: Appl. No. 645-11-0075 - Niagara Mohawk Power Corp.

DATE: January 21, 1977

Enclosed is a copy of an application under Section 15-0503 of the Environmental Conservation Law for a permit to build a dam.

Would you please review this within the area of your interest and let me have any comments or criticisms you care to make.

Encl.

SJZ:scs

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ALBANY, NEW YORK 12201

APPLICATION FOR PERMIT

for the Construction, Reconstruction or Repair of a Dam or Other Impoundment Structure under Conservation Law, Section 429 (c).

FOR DEPARTMENT USE ONLY
Application No. 645-11-0075
Dam No. 391
Watershed Oswegatchie

Read instructions on the reverse side before completing this application. Please type or print clearly in ink.

1. NAME AND ADDRESS OF APPLICANT
First Name | M.I. | Last Name | Phone No.
Niagara Mohawk Power Corporation | 315-474-1511
Street Address
300 Erie Boulevard West
Post Office | State | Zip Code
Syracuse | New York | 13202

2. NAME AND ADDRESS OF OWNER (If different from applicant)
First Name | M.I. | Last Name
SAME
Street Address
Post Office | State | Zip Code

3. TYPE OF PROJECT
☐ Construction ☐ Reconstruction ☒ Repair

4. IS STATE-OWNED LAND TO BE USED? ☐ Yes ☒ No

5. PROPOSED STARTING DATE: June 1, 1977

EXPECTED COMPLETION DATE: November 1, 1977

PROJECT DESCRIPTION Repair work to existing structure

LOCATION OF DAM
Stream or Body of Water: Oswegatchie River - Downs Falls Hydro Res.
County: St. Lawrence
Town: Clifton
Give distance and direction from commonly accepted landmar: 2-1/2 miles N.E. of Village of Oswegatchie

LOCATION ON U.S. GEOLOGICAL SURVEY MAP
Name of Map: Oswegatchie, N.Y.
Latitude: 44°-12'-45"
Longitude: 75°-02'-13"

8. PROPOSED USE FOR IMPOUNDED WATER: Existing hydroelectric generation

9. STATE THE HEIGHT ABOVE SPILLCREST OF THE LOWEST PART OF THE IMMEDIATE UPSTREAM ADJOINING PROPERTY OR PROPERTIES
Feet

IS THIS PROPOSED POND OR LAKE PART OF A PUBLIC WATER SUPPLY? ☐ Yes ☐ No
If not, where is nearest downstream public water supply intake?

11. SIZE OF AREA DRAINING INTO POND OR LAKE (Acres or Square Miles)
178 square miles

THE DRAINAGE AREA IS COMPOSED OF: (Total = 100%)
_____ % Forest _____ % Cropland _____ % Pasture _____ % Other _____ % Swamp _____ % Suburban Lands _____ % Urban Lands

TYPE OF SPILLWAY
☐ Service Spillway – Auxiliary Spillway Combination
☐ Single Spillway
☐ Pipe Riser ONLY
☐ Other _____

14. DESIGNER'S ESTIMATE OF CLASS OF HAZARD (As described in "Guidelines for Small Earth Dam Designs")
☐ Class "a" ☐ Class "b" ☐ Class "c"
NOTE: Provide descriptive information on character of downstream area.

SPILLWAY INFLOW DESIGN FLOOD
Frequency _____ Flood Peak _____ c.f.s. Runoff Volume _____ In.

15b. SERVICE SPILLWAY INFLOW DESIGN FLOOD
Frequency _____ Flood Peak _____ c.f.s. Runoff Volume _____ I

THE SINGLE SPILLWAY OR AUXILIARY SPILLWAY IS COMPOSED OF:
☐ Vegated Earth ☐ Concrete ☐ Timber ☐ Rock-filled Crib ☐ Masonry ☐ Other _____

MAXIMUM VELOCITY WITHIN THE SINGLE OR AUXILIARY SPILLWAY f.p.s.

18. SINGLE OR AUXILIARY SPILLWAY DISCHARGE AT DESIGN HIGH WATER c.f.s.

19. TYPE OF ENERGY DISSIPATER PROVIDED ON SINGLE SPILLWAY
☐ Hydraulic Jump Basin ☐ Drop Structure ☐ Other _____

POND OR LAKE WILL BE DRAINED BY MEANS OF

WATER WILL BE SUPPLIED TO RIPARIAN OWNERS DOWNSTREAM BY MEANS OF

HEIGHT OF DAM ABOVE STREAM BED
Feet

AREA-CAPACITY DATA Answer 1, 2 and 3, OR 1, 2, 4, 5	ELEVATION, Referred To Assumed Benchmark	SURFACE AREA	VOLUME STORED
1. Top of Dam	_____ Feet	_____ Acres	_____ Acre-Feet
2. Design High Water	_____ Feet	_____ Acres	_____ Acre-Feet
3. Single Spillway Crest	_____ Feet	_____ Acres	_____ Acre-Feet
4. Auxiliary Spillway Crest	_____ Feet	_____ Acres	_____ Acre-Feet
5. Service Spillway Crest	_____ Feet	_____ Acres	_____ Acre-Feet

TYPE OF ENERGY DISSIPATER AT OUTLET OF CONDUIT:
☐ Impact Basin ☐ Plunge Pool ☐ Hydraulic Jump Basin ☐ Other _____

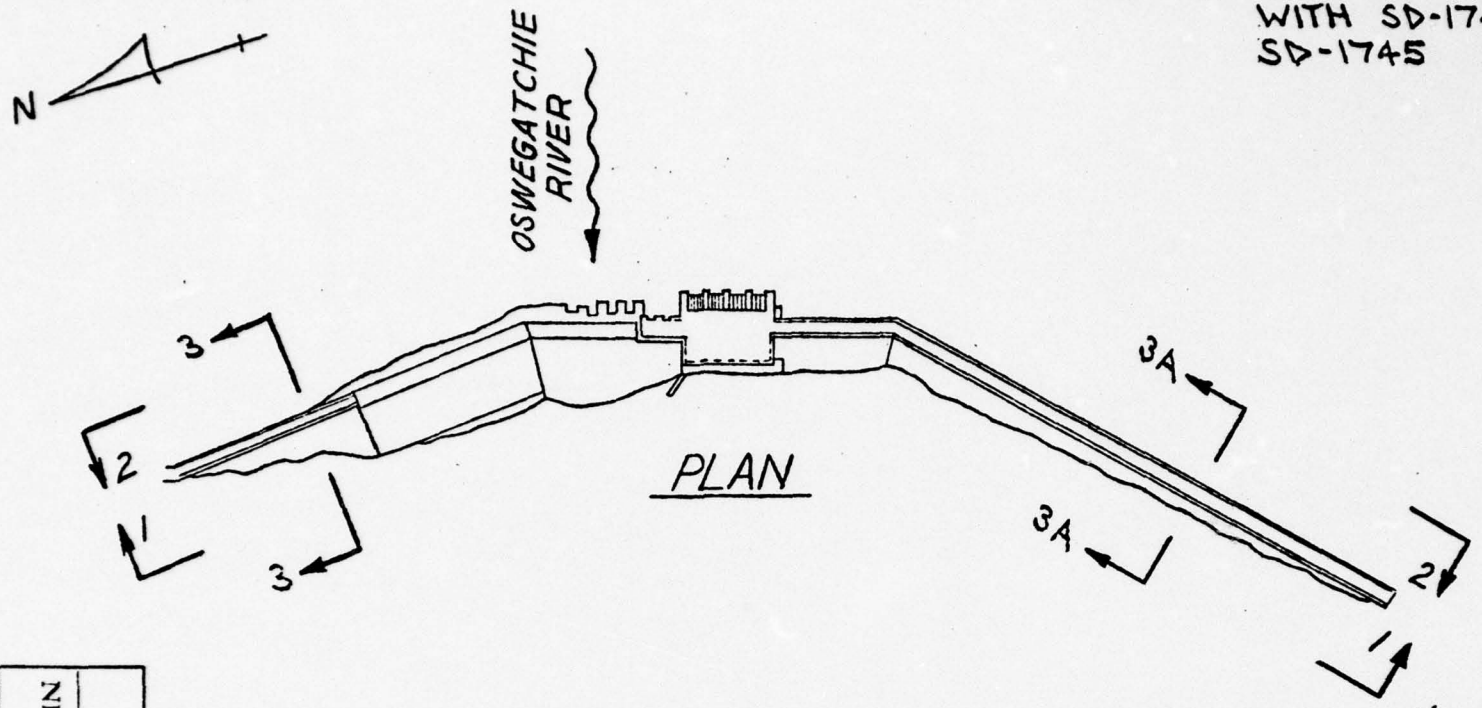
IS PIPE RISER PROVIDED WITH AN ANTI-VORTEX DEVICE? ☐ Yes ☐ No

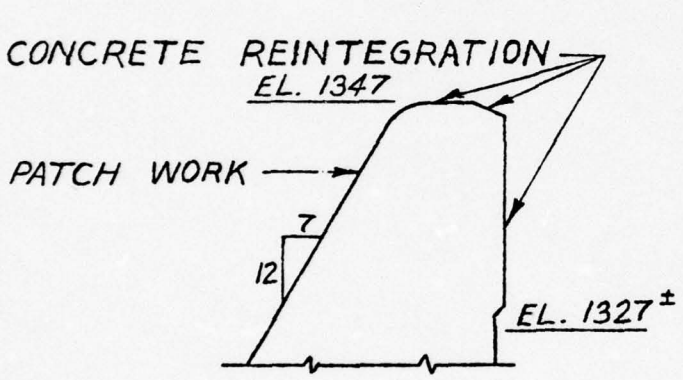
DRAWDOWN TIMES: Answer 1 and 2, or 1, 3 and 4

1. Has provision been made to evacuate 90% of the storage below the lowest spillway crest within fourteen days? ☐ Yes ☐ No
2. Can the single spillway evacuate 75% of the storage between the maximum design high water and the spillway crest within 48 hours? ☐ Yes ☐ No
3. Can the Service Spillway evacuate 75% of the storage between the auxiliary spillway and the Service Spillway crests within seven days? ☐ Yes ☐ No

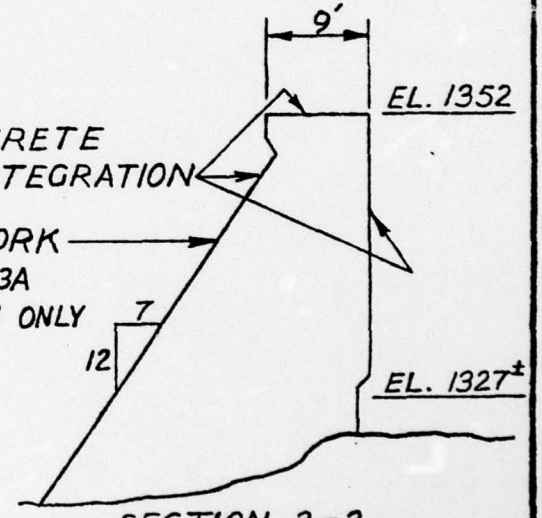
Can the Service Spillway and the Auxiliary Spillway in combination evacuate the storage between the design high water and the auxiliary spillway crest within 12 hours? ☐ Yes ☐ No

NOTE: WORK THIS DWG. WITH SD-1744 AND SD-1745





SECTION 4-4



SECTION 3-3
SECTION 3A-3A (AS NOTED)

NOTE:
FLOOD GATES TO BE OPENED AT START OF WORK AND TO REMAIN OPEN UNTIL COMPLETION OF WORK RESULTING IN POND DRAWDOWN.

NO.	DATE	BY	REVISION	CK.	APP.

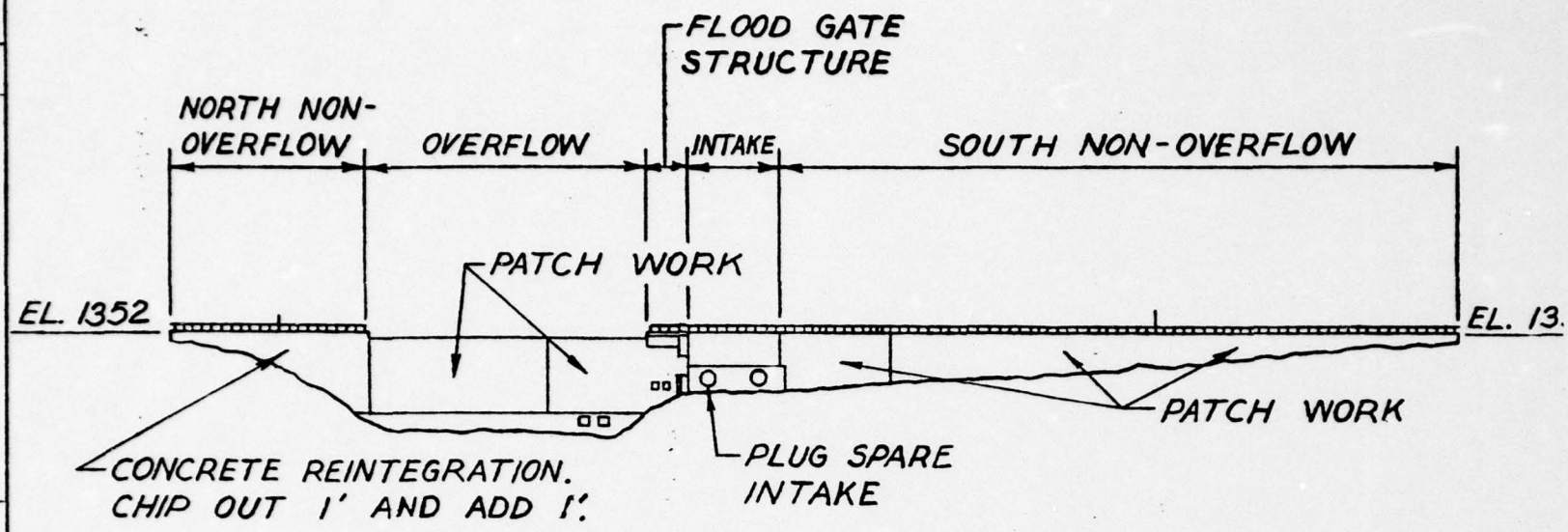
NIAGARA MOHAWK

NIAGARA MOHAWK POWER CORPORATION
SYRACUSE, N.Y.

BROWNSFALLS DEVELOPMENT
CONCRETE REINTEGRATION WORK

DES. J.I.	DR. CDC	TR.	CK J.I.	DATE 12/30/76
APPROVED	APPROVED		APPROVED	

SCALE NTS
INDEX 2-B16-H2
DWG. SD-1743



SECTION 1-1

NOTE: WORK THIS DW
WITH SD-1743 A
SD-1745

NO.	DATE	BY	REVISION	CK.	APP.

NIAGARA MOHAWK

NIAGARA MOHAWK POWER CORPORATION
SYRACUSE, N.Y.

BROWNSFALLS DEVELOPMENT

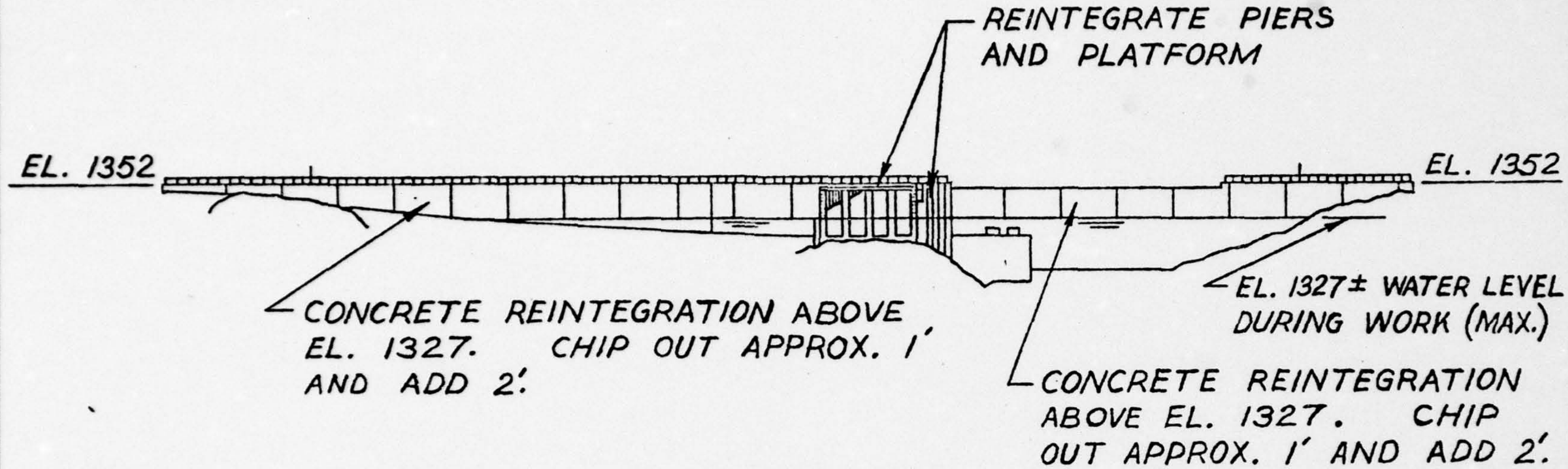
CONCRETE REINTEGRATION WORK

DES. J.V. DR. CDC TR. CK. J.V. DATE 12/30/76 SCALE NTS

APPROVED David L. Gould APPROVED APPROVED

APPROVED R.P.C. INDEX 2-B16-H2

NO. SD-1744



SECTION 2-2

NOTE: WORK THIS DWG. WITH SD-1743 AND SD-1744

NO.	DATE	BY	REVISION	CK.	APP.

NIAGARA MOHAWK

NIAGARA MOHAWK POWER CORPORATION
SYRACUSE, N.Y.

BROWNSFALLS DEVELOPMENT
CONCRETE REINTEGRATION WORK

DES. J.I.	DR. CDC	TR.	CK. J.I.	DATE 12/30/76	SCALE NTS
APPROVED David J. Yauch Jr.			APPROVED		INDEX 2-B16-H2
APPROVED RPF			APPROVED		NO SD-1745

23	45	13	00391	082071	004	4
RB	CTY	YR AP.	DAM NO.	INS. DATE	USE	TYPE

AS BUILT INSPECTION

1	Location of Sp'way and outlet	1	Elevations
1	Size of Sp'way and Outlet	1	Geometry of Non-overflow section

1 GENERAL CONDITION OF NON-OVERFLOW SECTION

1	Settlement	1	Cracks	1	Deflections
1	Joints	2	Surface of Concrete	1	Leakage
1	Undermining	1	Settlement of Embankment	1	Crest of Dam
1	Downstream Slope	1	Upstream Slope	1	Toe of Slope

1 GENERAL COND. OF SP'WAY AND OUTLET WORKS

2	Auxiliary Spillway	2	Service or Concrete Sp'way	1	Stilling Basin
1	Joints	2	Surface of Concrete	1	Spillway Toe
2	Mechanical Equipment	1	Plunge Pool	1	Drain

1	Maintenance	3	Hazard Class
3	Evaluation	39	Inspector

COMMENTS:

BROWNS FALLS

SMALL LEAKS IN WOODEN PENSTOCK

8-15-22-1000 (8-3740)

STATE OF NEW YORK

DEPARTMENT OF

State Engineer and Surveyor

ALBANY

Received June 1st 1922 Dam No. 391 Oswegatchie Watershed

Disposition Approved June 6th 1922 Serial No. 456

Site inspected

Foundation inspected

Structure inspected

Application for the Construction or Reconstruction of a Dam

Application is hereby made to the State Engineer, Albany, N. Y., in compliance with the provisions of Chapter LXV of the Consolidated Laws and Chapter 647, Laws of 1911, Section 22 as amended, for the approval of specifications and detailed plans, marked 42101, 42201 (2 sheets), 42206 (2 sheets) 42207

herewith submitted for the {construction / ~~reconstruction~~} of a dam located as stated below. All provisions of law will be complied with in the erection of the proposed dam.

1. The dam will be on East branch of Oswegatchie River in the town of Clifton, County of St Lawrence and one mile easterly of bridge at Browns Falls Plant (old)
(Give exact distance and direction from a well-known bridge, dam, village, main cross-roads or mouth of a stream)

2. The name and address of the owner is Northern New York Utilities, Inc. Watertown, N. Y

3. The dam will be used for power purposes

4. Will any part of the dam be built upon or its pond flood any State lands? no

5. The watershed at the proposed dam draining into the pond to be formed thereby is 178 square miles.

6. The proposed dam will have a pond area at the spillcrest elevation of about 200 acres and will impound 33 million cubic feet of water.

7. The lowest part of the natural shore of the pond is 10 feet vertically above the spillcrest, and everywhere else the shore will be at least feet above the spillcrest.

8. The maximum known flow of the stream at the dam site was 1890 cubic feet per second on Mar. 31, 1913
(Date)

9. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the proposed dam Yes

10. The natural material of the bed on which the proposed dam will rest is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.) granite rock except extreme north end which is sand loam

11. The material of the right bank, in the direct[illegible] current, is.....; at the spillcrest elevation this material has a top slope of.....inches vertical to a foot horizontal on the center line of the dam, a vertical thickness at this elevation of.....feet, and the top surface extends for a vertical height of.....feet above the spillcrest.

12. The material of the left bank is.....; has a top slope of.....inches to a foot horizontal, a thickness of.....feet, and a height of.....feet.

13. State the character of the bed and the banks in respect to the hardness, perviousness, water bearing, effect of exposure to air and to water, uniformity, etc.....The rock is not waterbearing and is impervious to water. The sand loam on the north end into which the key wall or anchor is to be made is hard, dense sand.....

14. If the bed is in layers, are the layers horizontal or inclined?..... If inclined what is the direction of the slope relative to the center line of the dam and the inches vertical to a foot horizontal?.....

15. What is the thickness of the layers?.....

16. Are there any porous seams or fissures?.....no.....

17. WASTES. The spillway of the above proposed dam will be 195 feet long in the clear; the waters will be held at the right end by a bulkhead wall the top of which will be 5 feet above the spillcrest, and have a top width of 8 feet; and at the left end by a embankment over ke the top of which will be 9 feet above the spillcrest, and have a top width of 20 feet.

18. There will be also for flood discharge a pipe.....inches in diameter and the bottom will be..... feet below the spillcrest, a sluice or gate.....feet wide in the clear by.....feet high, and the bottom will be..... feet below the spillcrest.

19. APRON. Below the proposed dam there will be an apron built of....., ... feet long,.....feet wide and.....feet thick. The downstream side of the apron will have a thickness of.....feet for a width of.....feet.

20. PLANS. Each application for a permit of a dam over 12 feet in height must be accompanied by a location map and complete working drawings of the proposed structure. Each drawing should have a title giving the parts shown, the name of the town and county in which the dam site is located, and the name of the owner and of the engineer.

The location map (U. S. Geological Quadrangle or other map) should show the exact location of the proposed dam; of buildings below the dam which might be damaged by any failure of the dam; of roads adjacent to or crossing the stream below the dam, giving the lowest elevation of the roadway above the stream bed and giving the shape, the height and the width of stream openings; and of any embankments or steep slopes that any flood could pass over. Also indicate the character and use made of the ground.

The complete working drawings should give [illegible]sions necessary for the calculations of the stability of the structure, and all the information asked for below under "Sketches." There may be attached to the plans any written reports, calculations, investigations or opinions that may aid in showing the data and method used by the designer.

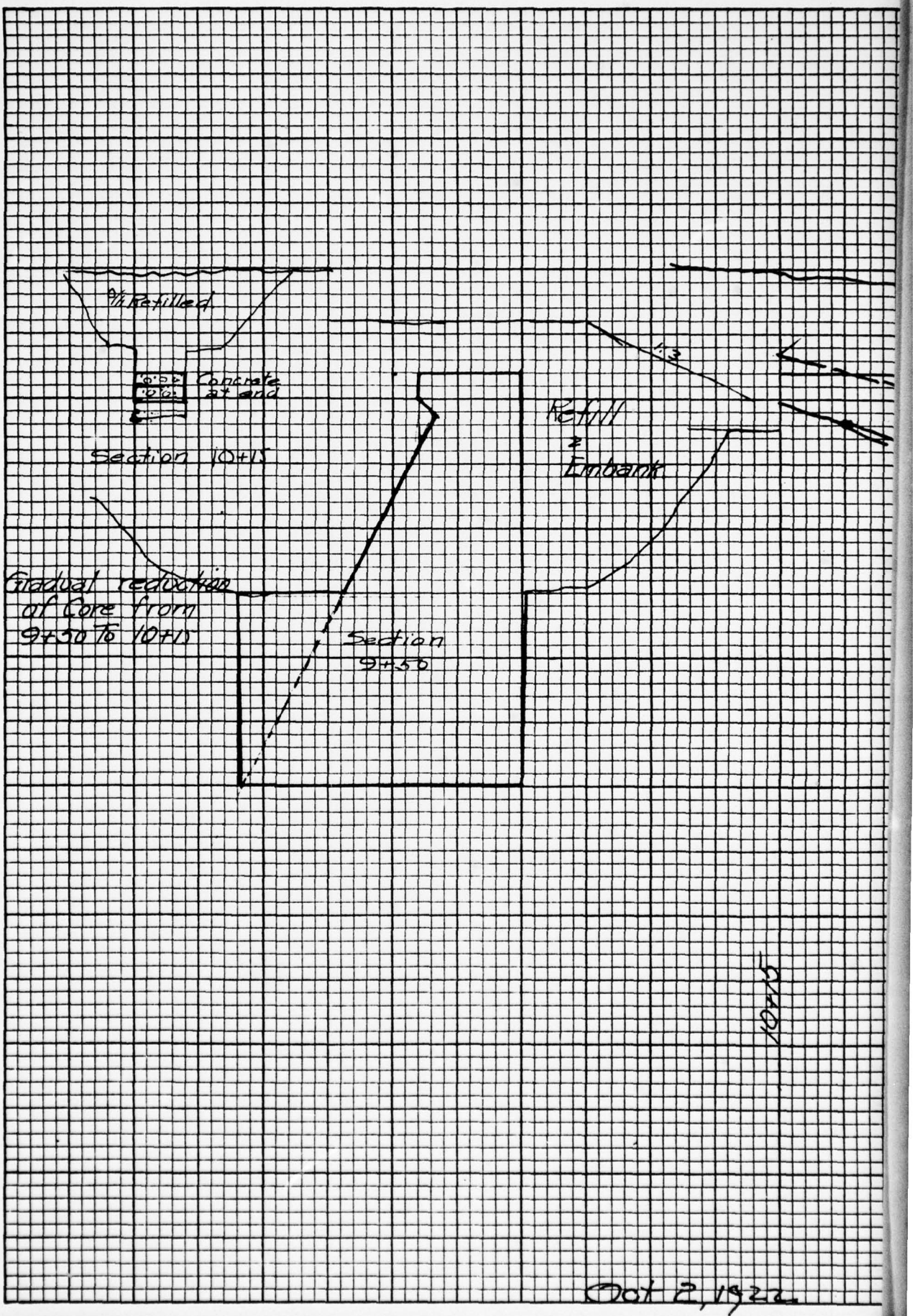
21. SKETCHES. For small and unimportant structures, if plans have not been made, on the back sheet of this application make a sketch to scale for each different cross-section at the highest point; showing the height and the depth from the surface of the foundation, the bottom width, the top width (for a concrete or masonry spill at 18 inches below the crest), the elevation of the top in reference to the spillcrest, the length of the section, and the material of which the section is to be constructed. Mark each section with a capital letter. Also sketch a plan; show the above sections by their top lines, giving the mark and the length of each; the openings by their horizontal dimensions; and the abutments by their top width and top lengths from the upstream face of the spillcrest and give the elevation of the top in reference to the spillcrest.

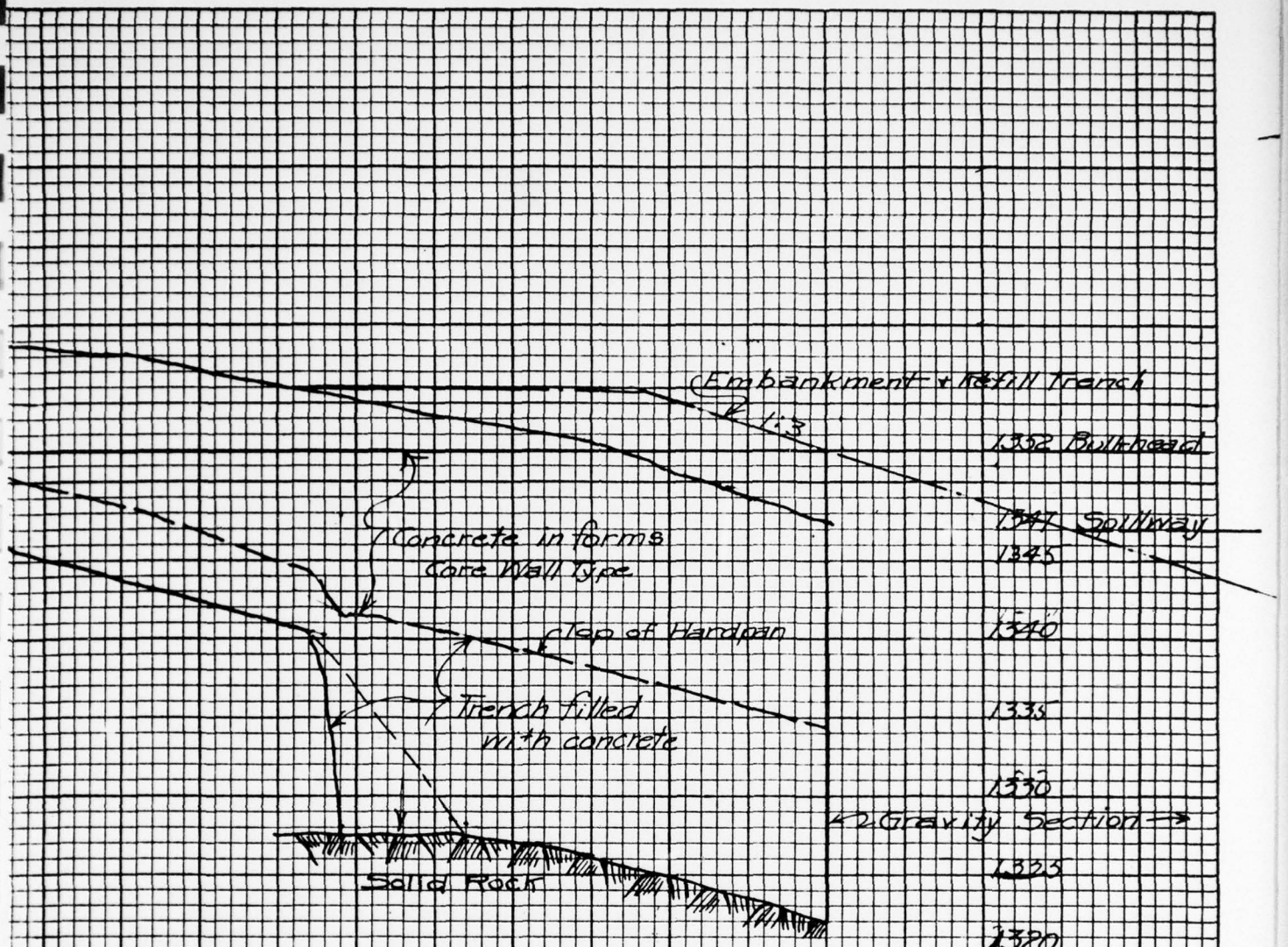
22. ELEVATIONS. Also give the elevations, if possible from the Mean Sea Level, of at least two permanent Bench Marks; of the spillcrest for any existing dam on the proposed dam site, at the middle and at both ends of the spill; and of the spillcrest for the above proposed dam.

23. SAMPLES. When so instructed, send samples of the materials to be used in the construction of the proposed dam, using shipping tags which will be furnished. For sand one-half a cubic foot is desired; for cement, three pints; and for the natural bed, twenty cubic inches.

24. INSPECTION. State how inspection is to be provided for during construction..... By inspectors employed by the chief engineer.

Note: For data not filled out, see plans.


9th Refilled
Concrete at end
Section 10+15
Refill & Embank
Gradual reduction of Core from 9+50 To 10+15
Section 9+50
Oct 2, 1922.



PROFILE SECTION

BROWNS FALLS DAM

OSWEGATCHIE RIVER

N.Y. UTILITIES, INC.

Watertown, N.Y.

J. P. Brownell, Engr.

Oswegatchie River

Dam No. 391 WATERS DEP.

Form No. IW86. 11-1-12-1000 (16-781)

RECEIVED
DEC 3 1913
DIVISION INLAND WATERS
Chief Engineer

GEORGE E. VAN KENNEN, CHAIRMAN
JAMES W. CEMING
JOHN D. MOORE
ALBERT E. HOYT
JOHN J. FARRELL
ASST. SECRETARY

STATE OF NEW YORK

DIVISION OF INLAND WATERS
JOHN D. MOORE, COMMISSIONER
JAMES J. FOX, DEPUTY COMMISSIONER
RICHARD W. SHERMAN, CHIEF ENGINEER
ALEX. RICE MCKIM, INSPECTOR OF DOCKS AND DAMS

CONSERVATION COMMISSION
ALBANY

Serial No. 141 SUPPLEMENTAL TO SERIAL No. 124.

Application filed Dec 1st 1913

Approved by Commission Dec 3d 1913

Material Tag No.

Foundations inspected

Final inspection Sept 23 - 13

APPLICATION FOR ~~CONSTRUCTION~~ OR RECONSTRUCTION OF A DAM

Benson Mines, N.Y.
(Address of Applicant)

Application is hereby made to the Conservation Commission of the State of New York, in compliance with the provisions of Chap. LXV of the Consolidated Laws, the Conservation Law, for approval of the detailed specifications and plans, marked Benson Mines Co. Benson Mines, N.Y. Cross Section of Proposed Dam on Oswegatchie River. 5020 herewith submitted, for the { ~~construction~~ / reconstruction } of the dam herein described. All provisions of law will be complied with in the erection of the said dam, whether specified herein or not.

December 2, 1913
(Date)

{ Signature of Applicant } Benson Mines Co.

Engineer

LOCATION AND GENERAL DATA

Site of dam is on East Branch of Oswegatchie River
(Name of stream)
a branch of the Oswegatchie River
(Name of stream)
, within the limits of the town of Clifton, County of St. Lawrence.
3,000 ft. upstream from Benson Mine Co's present hydro-electric plant at Browns Falls,
(Give approximate distance from well-known bridge, dam, village or mouth of stream, so that work can be located on map of state)
1/2 mile west of Old Albany Road Ford and 2 3/4 miles North-east in air line from Oswegatchie R.R. station. Near town line of Clifton and Fine.

Purpose of dam to store water for present plant and also to furnish hydro-electric power to operate concentrating plant of Benson Mines Co.

Reasons for making changes in existing structure
To obtain additional storage usable for power

DATA AND DIMENSIONS

General:

Materials of which dam is to be constructed Concrete 1:2:4 and 1:2½:5 Edison Portland cement, gravel as per sample, clean stones and boulders (Granite ledge

Area of watershed above dam 178 square miles.

Area of water surface of pond at level of spillway crest 35 4/10 acres acres.

Capacity of reservoir (at above level) 15,400,000 cubic feet.

Length of spillway crest 150 feet.

Maximum depth of water on spillway crest 6 feet.

Maximum discharging capacity of spillway cubic feet per second.

Maximum discharging capacity of spillway per square mile of drainage area

cubic feet per second.

Masonry or timber portion:

Length on top 400 feet.

Length in stream bed 50 feet.

Maximum height above stream bed 34 feet.

Maximum height above foundation bed 35 feet.

Maximum width of base 26 ft. for abutment; 32'-6" for roadway feet.

Maximum width of top 4' for abutment; 8' for spillway feet.

Elevation of top above maximum water level in pond ..... feet.

Elevation of top above spillway crest 6 feet.

Nature of foundations Solid Granite

Earth portion:

Embankment:

Length on top ..... feet.

Length in stream bed ..... feet.

Maximum height above stream bed ..... feet.

Maximum width of base None feet.

Maximum width of top ..... feet.

Elevation of top above maximum water level in pond ..... feet.

Elevation of top above spillway crest ..... feet.

Slope, upstream face .....

Slope, downstream face .....

Core wall:

Material .....

Elevation of top above spillway crest None feet.

Width of top ..... feet.

Batter of faces .....

Maximum height above foundations ..... feet.

Maximum width of base ..... feet.

Sheeting or other cut-off. none necessary

Is fishway provided? No fish in stream

General description of regulating works, gate houses, outlet pipes, penstocks, forebays, canals, flashboards, gates, log chutes, etc.

Two 5'-6" x 5'-6" sluice gates discharging into river bed
Two 6'-0" x 10'-0" penstock gates.
All gates to have hand hoists.
Trash racks to run parallel to river

Names of owners of property which will be submerged by construction of dam, with approximate submerged area owned by each.

All property owned by Benson Mines Co.

It is intended to complete work covered by this application by January 1, 1914 (Date)

REPORT UPON APPLICATION

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany Dec 2d 1913

I have carefully examined the plans of the above dam, and find that if the work is constructed in accordance with the plans, filed Dec 2d 1913 with good workmanship and the specified materials that it will be safe.

110

Approved:

R W Shuman
Chief Engineer.

Alex Rice McLean
Inspector of Docks and Dams.

APPROVAL BY COMMISSION

STATE OF NEW YORK

CONSERVATION COMMISSION

ALBANY

On Dec. 3 1913 the Conservation Commission, by resolution duly adopted, approved of the above application for the { ~~construction~~ / reconstruction } of dam 391 Owegatchie on Owegatchie River and hereby gives permission for the { ~~construction~~ / ~~reconstruction~~ } of said dam within twelve months from date in accordance with the specifications and plans, and subject before erection to the approval by the Inspector of the materials of construction and of the foundation bed when stripped and prepared, and subject to the inspection of the work during and after construction. This approval may be amended if deemed necessary to secure a safe structure.

(Seal)

.....
Secretary to Commission.

REPORT ON INSPECTION OF FOUNDATION

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany.....

Work on the above dam was started....., contracts for the same having been awarded to.....

.....

On .....

.....

.....

.....

Approved:

.....
Inspector of Docks and Dams.

.....
Chief Engineer.

REPORT ON COMPLETION OF WORK

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany Sept 28 - 15

On Sept 23 - 15 I inspected the above work and found that it had been completed in a satisfactory manner.

Approved:

Allen Rice McLean
Inspector of Docks and Dams.

.....
Chief Engineer.

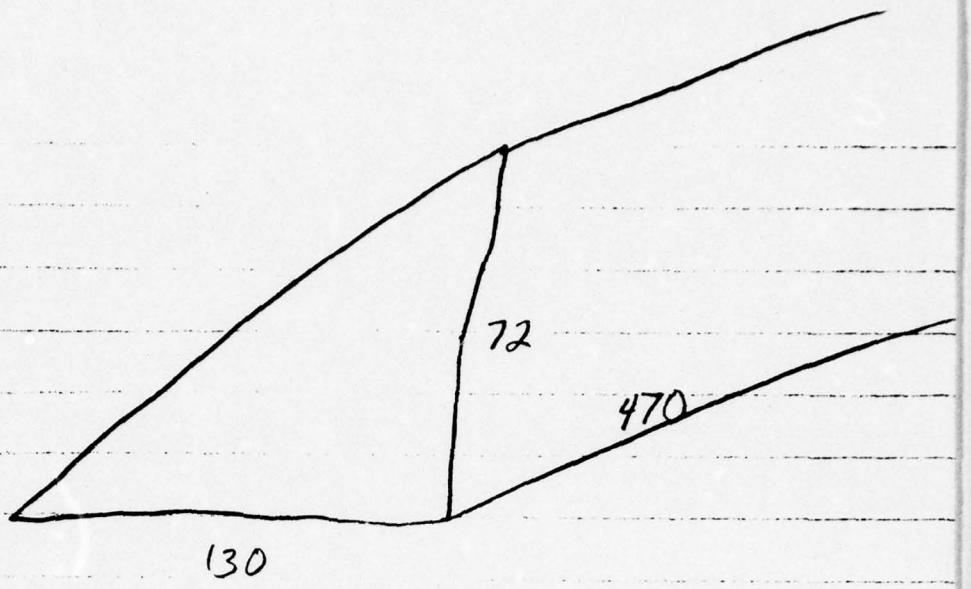
INSTRUCTIONS TO APPLICANTS

Requirements for Plans.—Before beginning the construction, reconstruction, alteration or extension of a structure for impounding water, the owner of the proposed structure shall submit, in duplicate, to the Conservation Commission complete drawings showing the location of the dam, the flow line of the impounded water, the boundary lines and the ownership of the property affected, the nature of the foundation bed, the character of the materials to be employed, the size and the location of the discharge and control gates, the general and special features of the dam, and such dimensions as are necessary for the calculation of the stresses and the erection of the structure.

Drawings shall be on sheets of uniform size 24 inches wide by 36 inches long. Each sheet shall have a white space 2¾ inches high by 5½ inches long below the title to receive the stamp of approval. On each sheet of every set of drawings there shall be clearly printed a conspicuous title in which shall appear the name of the county, the name of the city, village or town, and the name of the stream in which the dam is located, and the name of the owner thereof. The scale of the drawings shall be stated under the title. When the designs have been approved by the Commission, one set will be returned to the owner, with such approval endorsed thereon. Copies in duplicate of the specifications under which the dam is to be constructed shall accompany the plans.

Inspection.—The name of the inspector and a statement of his experience in such work must be sent to the Commission. There must also be sent a sample of at least one-half a cubic foot of sand and of cement, and twenty cubic inches of the stone for concrete or masonry to be used in the structure, and of the natural materials in the foundation bed. The foundation bed, after it has been cleared and prepared, must be inspected subject to approval by the Inspector of the Commission. The inspection of materials takes about ten days in the laboratory. On request tags will be sent for labeling the materials.

Super 23-15. 6 wires on ... pealed off. Hand under math A R Mathis



$$V = \frac{(72)(130)(470)}{54} = 81466 \text{ cu yd}$$

Sampling Capacity

$$\begin{array}{r} 757 \text{ cu ft.} \\ 43560 \overline{)\ 33{,}000{,}000} \end{array}$$

SUBJECT Dam 391 Ossegatchie Newton Falls. FILE NO.

C R McKinney ACC. NO.

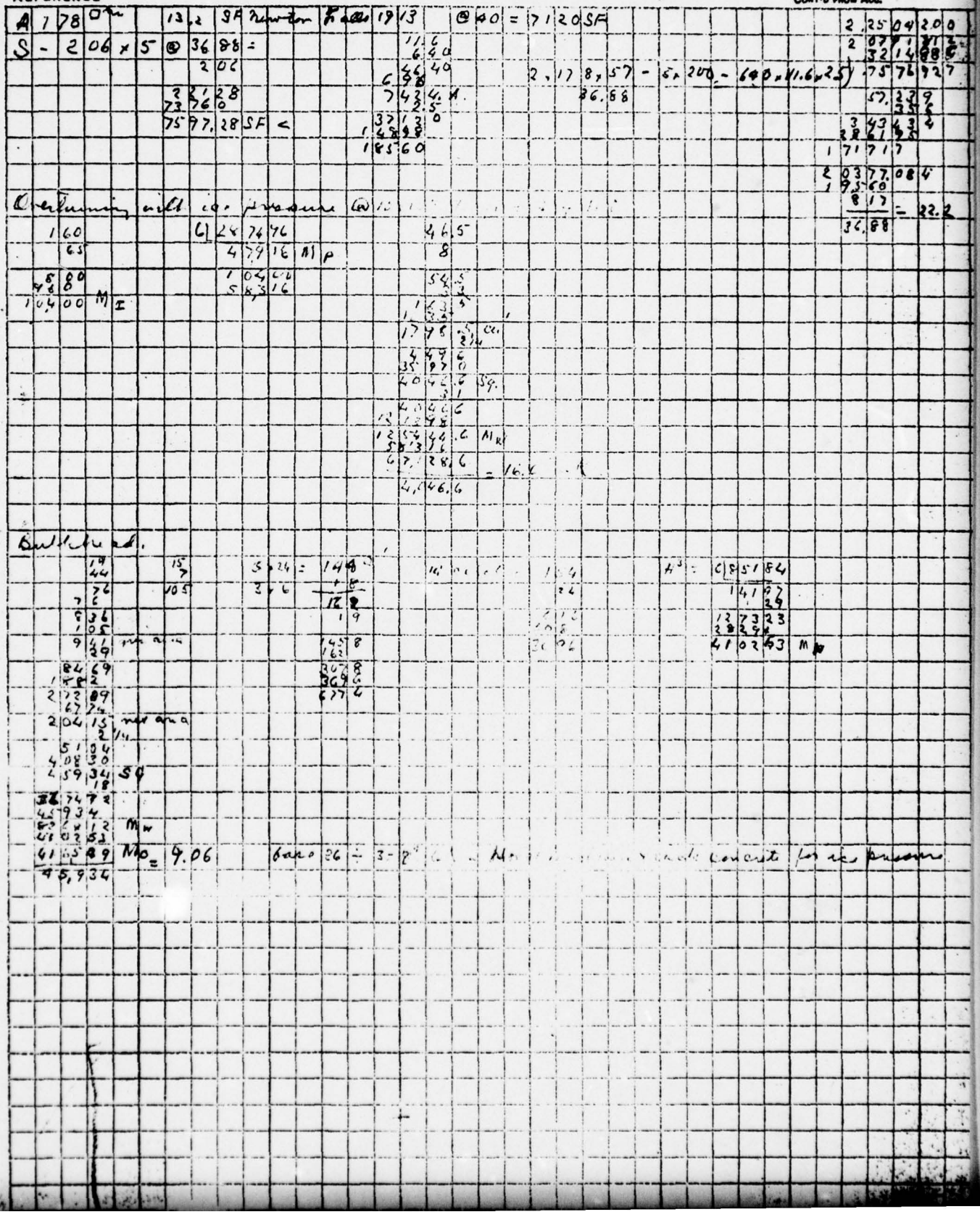
SHEET

COMPUTER June 5 1922 CHECKED BY 19

MADE IN CONNECTION WITH

REFERENCE

CONT'D FROM ACC.



STATE OF NEW YORK CONSERVATION COMMISSION

SUBJECT Dam No. 311, Oswegatchie River at Brown's Falls, - Investigation of Stability — Application #141

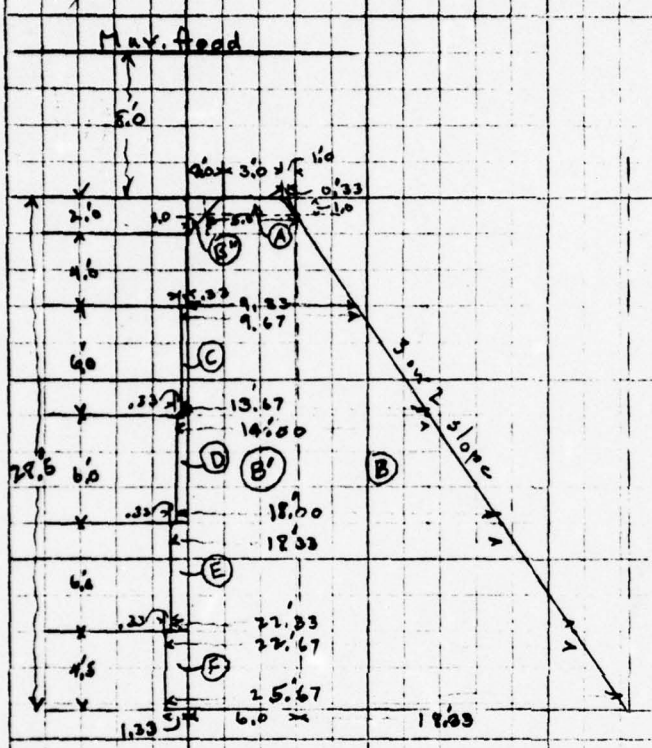
FILE NO. [illegible]

ACC. NO. 8 456

SHEET 1

COMPUTER E. H. Cullings Left 27 1913 CHECKED BY 19

MADE IN CONNECTION WITH Report to Chief Eng



CONT'D FROM ACC.

Spillway length = 150 ft.
Max. depth of water = 8.0 ft.
Discharging capacity; —

$3.75 \times 150 \times 8^{\frac{3}{2}} = 12,700$ sec. ft.

Drainage area = 178 sq. mi.
Dis. Capacity = 71 sec-ft / sq. mi.

Max. discharge will probably not exceed 40 sec. ft per sq. mi.

Assume ice pressure of 28000 #. per sq. ft. acting 2.0 ft. below crest.

Assume uplift due to full static head acting at heel, and decreasing uniformly to zero at toe over entire width of base.

Assume wt. of masonry = 150 #/cu. ft (Rm. Hb. p. 279)

Resisting Moment of Masonry at Base; —

					Static Moment
Sec. A	$\frac{3.0+5.0}{2} \times 1.0 =$	$4.0' \times (24.33 - 3.50)$		=	83 ft~
Sec. B	$\frac{18.33}{2} \times 27.50 =$	$254.0' \times$	12.22 =	=	3055 "
Sec B'	$6.0 \times 27.5 =$	$166.0' \times$	21.38 =	=	+3520
Deduct B",	$\frac{1.0}{2} =$	$-0.5 \times$	24.00 =	=	-12 3508 "
Sec. C	$6.0 \times .33 =$	$2.0' \times$	24.50	=	49 "
Sec D	$6.0 \times .67 =$	$4.0 \times$	24.68	=	99 "
Sec E	$6.0 \times 1.00 =$	$6.0 \times$	24.83	=	149 "
Sec. F	$4.5 \times 1.33 =$	$6.0 \times$	25.00	=	150 "
		438.5			7093 "

Cen. Grav. F = $\frac{7093}{438.5} =$ 16.17 from toe

Res. Mom. = $438.5 \times 150 \times 16.17 =$ 1,064,000 ft#

STATE OF NEW YORK CONSERVATION COMMISSION

SUBJECT Van. No. 391, Oswegatchie River at Brown's Falls — App # 141

FILE NO. ~~D 6344-56~~

ACC. NO. 0 457

SHEET 2

COMPUTER E.H. Gillings Sept 29 1913 CHECKED BY ____ 19____

MADE IN CONNECTION WITH

COST'D FROM ACC. C-456

Overturning Moment

$62.6\left(\frac{36.5^3}{6} - \frac{8.0^2}{2}\times 31.17\right) =$ 444000 '#

Uplift:— (Over whole base) $62.6 \times 36.5 \times \frac{25.67}{2} \times \frac{25.67 \times 8.56}{3} =$ 501000

Total 945,000 '#

Uplift (Over ⅔ base)

$\frac{167000}{501000} \times \frac{2}{3} =$ 334000 '#

444000

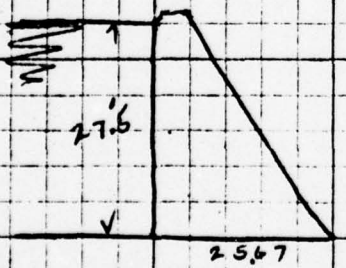
Total 778,000 '#

Resisting Moment = 1,064,000 '#

Unsafe under above conditions

V.

Water surface 1 ft. below crest; Ice pressure of 28000 #/lin ft.



Res. Mom. = 1,064,000 '#

O.v. Mom.

Ice:— $28000 \times 27.5 =$ 770,000 '#

Water:— $\frac{27.5^3}{6} \times 62.5 =$ 216,000 '#

Uplift. $\frac{2}{3} 62.5\left(27.5 \times \frac{25.67}{2} \times \frac{25.67 \times 8.56}{3}\right)$ 250,000

1,236,000 '#

Unsafe under above conditions

Sliding:—

Wt of dam = $438.5 \times 150 =$ 65900 #/lin ft.

(1) Hor. Comp. of W. $\frac{36.5^2 \times 62.5}{2} =$ 41700 #

Coef. of fric. = $\frac{41700}{65900} =$ 0.63 Too high.

(2) Hor. comp of W. = $\frac{27.5^2}{2} \times 62.5 =$ 23700 #

Ice 28000

51700 #

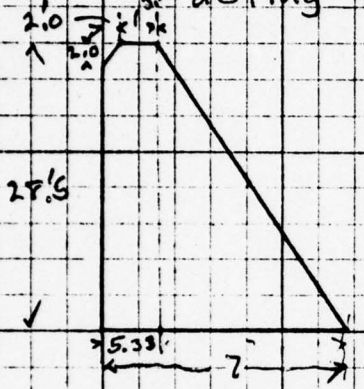
Coef. of friction = $\frac{51700}{65900} =$ 0.785 Too high.

MADE IN CONNECTION WITH

COST'D FROM ACC. C-457

Design of Dam.

Flood Height :— 8.0 ft above crest.
Ice Pressure :— 28000# / lin ft, applied 1ft below crest.
Uplift :— Full static pres. at heel; decr. unif. to zero at toe; acting over 2/3 base



Overturning Moment :—
Water :— $\gamma\left(\frac{H^3}{6} - \left[\frac{Hb^2}{2} - \frac{b^3}{3}\right]\right)$ $\gamma = 62.5$, $H = 34.6$, $b = 8$

$= \gamma\left(\frac{8100}{6} - \frac{34.5 \times 64}{2} - \frac{171}{3}\right) = 71068\gamma$
$= 444000$ #

Uplift $= \gamma H \cdot \frac{Z}{2} \cdot \frac{2}{3} \cdot \frac{Z}{3} = \frac{2}{9}\gamma H Z^2 = 8.1 \cdot 8Z^2$

$8.1 \times 900 = 7300\gamma$
$= 456000$ #

1. $Z = 30$

Res. M. $= \left[5.33 \times 28.6 \left(30 - \frac{5.33}{2}\right) - 2.0 \times (30 - 0.67)\right] = 4091$

$(30.0 - 5.33) \times \frac{14.25}{2} \times (30.0 - 5.33) \times \frac{2}{3} = 5800$

Total 9891

R.M. $= 9891 \times 150 = 1480000$ #
O.M $= 900000$

2. $Z = 32$

R.M $= (152 \times 29.33 - 2.0 \times 31.33) \times 150 = 660000$ #

$24.67 \times 14.25 \times 24.67 \times \frac{2}{3} \times 150 = 1015000$
1676000 #

O.M Water $= 444000$ #
Uplift $506 \times 32^2 = 519000$
963000

3. $Z = 35$

$(152 \times 32.33 - 2.0 \times 34.33) \times 150 = 727000$ #
$29.67 \times 19.25 \times 29.67 \times \frac{2}{3} \times 150 = 1220000$
1947000

OM Water $= 444000$ #
Uplift $506 \times 35^2 = 620000$
1064000

COST'D ON ACC. C-459

STATE OF NEW YORK CONSERVATION COMMISSION

SUBJECT Dam No. 391 - U.S.W.K. at Browns Falls. FILE NO. ~~D 503-4.0~~

ACC. NO. 0 459

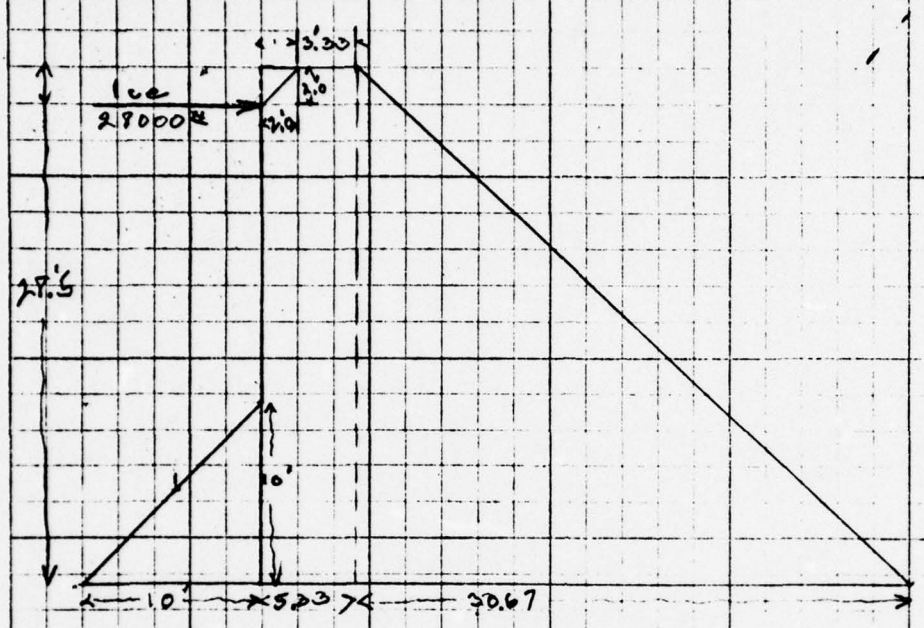
App* 141

SHEET 4

COMPUTER H. Cullings Sept 29 1942 CHECKED BY 19

MADE IN CONNECTION WITH

CONT'D FROM ACC. C-458



Resisting Moment.

$10 \times \frac{1.0}{2} \times 150 \times 39.33 = 295{,}000$ ✓

$5.33 \times 28.5 \times (36.00 + 3.33 + 2.67) \times 150 = 758000$ ✓

$30.67 \times \frac{28.5}{2} \times 150 \times 20.42 = 1{,}340{,}000$ ✓

$62.5 \times 10 \times (28.5 - 2 - 5) \times 41.0 = 550000$ ✓

2,943,000

Overturning Moment

Water $\frac{26.5^3}{6} \cdot 62.5 = 194000$ ✓

Ice $28000 \times 26.5 = 743000$ ✓

Uplift $\frac{7}{9} H^2 \gamma = \frac{7}{9} \times 26.5 \times 46^2 \times 62.5 = 780000$ ✓

1,717,000

E OF NEW YORK CONSERVATION COMMISSION

SUBJECT Dam No 241 - U.S.W.K. at Brown's Falls FILE NO. [illegible]

ACC. NO. C 460

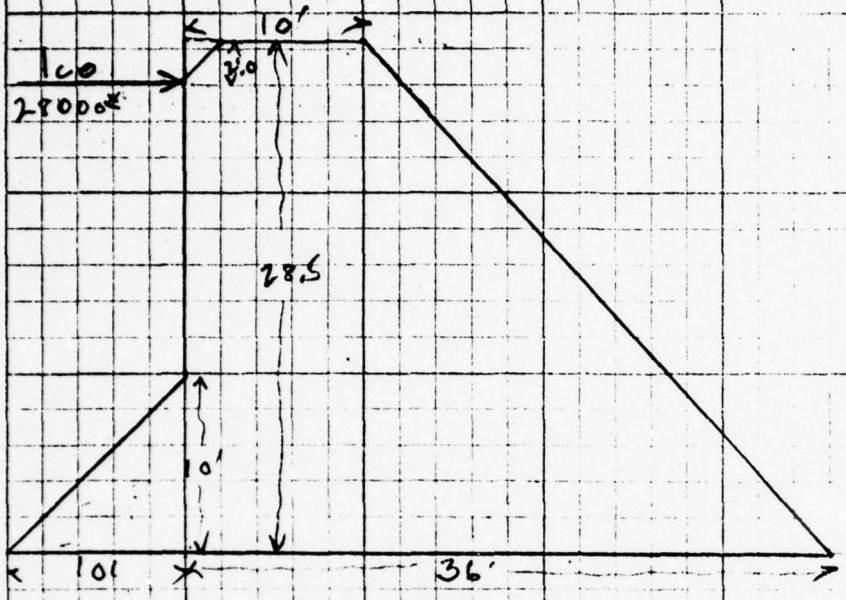
App. # 141

SHEET 5

COMPUTER D. Collings Sept 29, 1913 CHECKED BY ..... 19.....

MADE IN CONNECTION WITH

CONT'D FROM ACC. C-459



R.M.

50 $\frac{10 \times 10}{2} \times 39.33 \times 150 = 295000$ #1 ✓

285 $10 \times 28.5 \times 31.0 \times 150 = 1330000$ ✓

370 $\frac{26}{2} \times 28.5 \times 17.33 \times 150 = 965000$ ✓

705 $62.5 \times 10 \times 21.5 \times 41.0 = 550000$ ✓

3,140,000 #1 ✓

O.M. 1,717,000 #1

485?

E OF NEW YORK
ONSERVATION
COMMISSION

SUBJECT Dam # 391 - Owegatchie River at Benson Mines FILE NO. ~~D-50-1-64~~

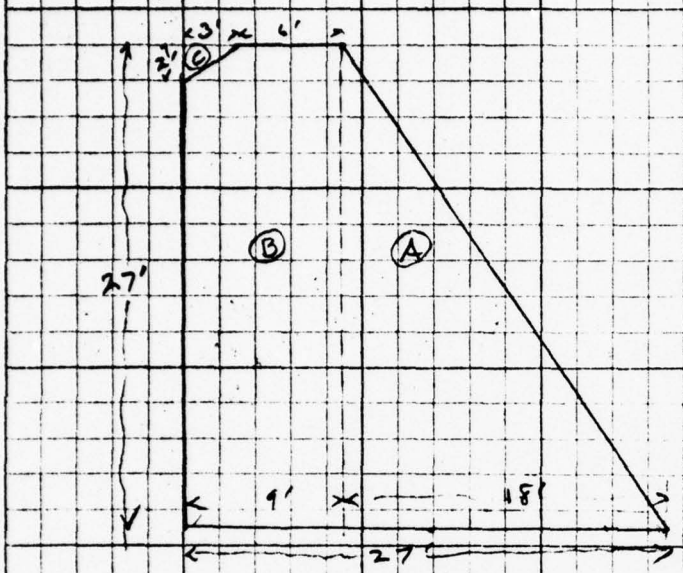
Revised Section — Stability ACC. NO. C 483

App. # 141 SHEET 6?

COMPUTER E. H. Cullings Oct 4 1913 CHECKED BY ..... 19....

MADE IN CONNECTION WITH

CONT'D FROM ACC. C 460?



Wt. of Masonry, 150 #/cu.ft.

Resisting Moment.

A: $\frac{27 \times 18}{2} \times 12 \times 150 = +\ 448000$ '#

B: $27 \times 9 \times 22.5 \times 150 = +\ 820000$

1268000

C: $\frac{2 \times 3}{2} \times 26 \times 150 = -\ 11700$

Total 1256300 '#

Area = 483 □'

Vert. Comp = $483 \times 150 = 72500$ #

Overturning Moment

Water $\frac{rh^3}{6} = \frac{62.5 \times 25^3}{6} = 162,500$ '#

Uplift, (Over whole base) $= \frac{rh \cdot 2}{2} \cdot \frac{27}{3} = \frac{rh2^2}{3}$

$= \frac{62.5 \times 25 \times 27^2}{3} =$ 380,000 '#

Ice, (43000 #/lin.ft.)

$43000 \times 25 =$ 1075000 '#

Total 1617,500 '# (1)

Uplift (Over 2/3 base) = 255000

Ice (28000 #/lin.ft.

$28000 \times 25 =$ 700000 '#

Total 1117,500 (2)

Ice (14000 #/lin.ft.)

14000×25 350000 '#

Total 767500 '# (3)

MEMORANDUM FOR HON. FRANK M. WILLIAMS, STATE ENGINEER.

On September 22nd, I inspected with James P. Brownell, Engineer for the New York Utilities, Inc., Dam No. 391, Oswegatchie Watershed, near Newton Falls.

The south end of the dam rests upon ledge to within 40 feet of the non-overflow part of the dam, where the ledge is nearly up to the flow line; then the ledge dips down away from the stream and here the wall is carried 10' deep by 4' wide and will have banks on both sides.

On the north end at the bend, Station 9+50, the ledge is 20' below the top of the non-overflow and 15' below the natural bank as at present excavated.

From Station 9+50 to Station 9+67 the wall is narrowed in a trapezoidal shape and rests entirely on the ledge. At Station 9+67 the base will be 9' wide with a batter of 1 horizontal to 4 vertical on the downstream side to a top width of 4'. At Station 9+67 the core wall proper commences and for 6' will be on the ledge and beyond the base will rise and be on an earth bed up to Station 9+95, where the wall will be 4' thick and 4' deep into the natural bed and banked on both sides.

The dam will probably be finished about Oct. 15th, and I consider that public safety will be assured with the above construction.

Inspector of Docks and Dams.

September 25, 1922.

ARMcK-F.

Dam No. 391,
Oswegatchie,
Newton Falls.

September 18, 1922.

Mr. James P. Brownell,
Carthage, N. Y.

Dear Sir:

Concerning our letter of September 2nd, our Mr. McKim can arrange to leave Carthage for Oswegatchie on the early train Friday morning next, if that will be convenient for you.

Very truly yours,

FRANK M. WILLIAMS,
State Engineer,

By _____
Deputy State Engineer.

Subject -
Dam No. 391 Oswegatchie
Newton Falls;

September 2, 1922 ARMcK-M

Mr. James P. Brownell
Carthage,
New York.

Dear Sir:

Yours of August 31st received stating that the rock is stripped for the dam at Browns Falls, dam No. 391 Oswegatchie Watershed.

Mr. McKim will be unable to come up just at present but may be able to do so later. Do not however, delay the work of starting the foundation as we will get a report from you thereon.

Yours very truly,

FRANK M. WILLIAMS,
State Engineer,

BY

Assistant Deputy.

391 Oswegatchie

James P. Brownell
M. Am. Soc. C.E.
Civil and Hydraulic Engineer
Carthage, New York

August 31, 1922.

Frank M. Williams
State Engineer & Surveyor
Albany, N.Y.

Dear Sir:

We have all the rock stripped for the dam at Browns Falls, Oswegatchie River, Oswegatchie, N.Y., and wish if Mr. McKim is going to inspect the site again, that he would do so at once. We have taken down the face of the earth in many cases vertically so as to place the concrete directly against the excavated earth lines. These sides of course would not stand too long in their present condition, and we are anxious to place concrete as soon as the rock is cleared and washed and the anchor pins set.

Yours very respectfully,

JPB:BS

James P. Brownell

Aug 31, 1922

Mr Frank M Williams
State Engineer
Albany N.Y.

Dear Sir:—

The portions of the dam site at Browns Falls, Owegatchie N.Y. which was covered by earth is now stripped and ready for inspection. We desire to place the concrete at once as the sides have been excavated nearly vertical and we fear rain might cave in the sides.

The rock foundations on the north end of dam has been found 18 feet higher than anticipated.

Yours very respectfully

Jannes P Bowers
Engineer

ARMcK-F.

July 25, 1922.

Dam No. 391, Oswegatchie,
Newton Falls.

Mr. James P. Brownell,
Carthage, N. Y.

Dear Sir:

We have received your letter of July 24, enclosing four sections and two photographs of the dam under erection at Browns Falls Development at Newton Falls.

We note the additional reinforcement in the trenches. These trenches, we assume, will be packed with concrete tightly against the natural earth.

Very truly yours,

FRANK M. WILLIAMS,
State Engineer

By _____
Assistant Deputy.

James P. Brownell
M. Am. Soc. C.E.
Civil and Hydraulic Engineer
Carthage, New York

July 24, 1922.

Frank M. Williams
State Engineer
Albany, N.Y.

Gentlemen:

In reply to your letter regarding location of sections on which pins will be set, I will have this done.

Enclosed I am sending four cross-sections - 2+20, 2+57, 2+93, and 3+54. The rock from the zero or southerly end has been stripped and followed to Sta 2+20. It has been again uncovered and stripped at 3+54 at which point it was found higher than estimated. Between these two points we have sunk test pits at Sta 2+57 and 3+54 and find rock at elevations 1312 and 1309 respectively. The ground as staked out and so far trenched is not wide enough to carry the toe of dam to rock. There is a large cement shed adjacent, and I do not like to widen trench lines if possible.

After getting below the surface, full of boulders, the ground is a hard clay, requiring plowing and picking in order to scrap. It is generally a dry clay but there is some water running over the ground and into the excavation from the springs in the land above, and which is held by the rock below. The excavation for the test pits came out dry clear to rock but with a certain amount of contained moisture. All sides are nearly vertical and have held perfectly during the heavy rains during the past few weeks.

It does not appear to me necessary to widen the trench in this section to secure the 7 to 12 pitch throughout I believe that by casting the trench full up to elevation 1330 and from above with a regular type section, that the combined section will be fully if not more secure than a typical section in the open.

On two sheets I have drawn sketches of Sta 2+57 and 2+93 showing my idea and also strains.

The base of the dam will all be on solid rock, and I have threfore assumed the water pressure acting against the whole face from rock up to 1348, the point at which I consider will be the height of water when greatest combined water and ice pressure occurs. The resultant of these pressures and that of the concrete about the toe "G" gives factors of safety of 1.56 and 1.38 respectively, irrespective of any pressure that might be exerted by the mass of natural earth below the dam.

For a factor of safety of 2 for an overturning moment about the toe "G", there would have to be taken by the earth against "G-H", 484,240 lbs. and 623,755 lbs. respectively. As a resistance to overturning the distribution of unit pressure against the earth surface "G-H" would be a zero at "G" and reach a maximum at "H", which readily shows the maximum pressure to be 4480 and 4240 respectively.

By combining the resultant of the earth pressure or resistance thus computed with the resultant of the concrete, water and ice pressures, the combined resultants will be found within the middle third.

The earth as found and with concrete filled against the sides of excavation without forms, should safely carry all of two tons per square foot assumed.

Kindly let me know your approval or comments on this scheme. The excavation has been carried along intermittently as teams from other work could be spared.

I would also propose to put a line of vertical reinforcement set into holes drilled in the rock about 2 feet back from the face of excavation. Such reinforcement of $\frac{7}{8}$ inch square bars anchored in the rock at one foot intervals would give a resistive moment of 180,000 foot pounds, or 60,000 foot pounds at 3 feet intervals. This factor has not been considered, although I believe it would be advisable to place such reinforcement, which we have done up to Sta 2+20.

The slope of the rock at 2+20 and 3+54 are against pressure. The rock at 3+54 will continue some distance back before it will be necessary to go to a trench filled section.

The site is available now for inspection, but it will be two weeks or more before it is entirely stripped.

Yours very respectfully,

JPB:BS

James P. Boswell

ARMcK-F.

July 21, 1922.

Dam 391, Oswegatchie
at Browns Falls

Mr. James P. Brownell,
Carthage, N. Y.

Dear Sir:

We have received your letter of July 19, enclosing prints for sections of the dam from Station 1+35 to Station 8+10.

If you have the records, will you kindly send us a description and the stations between which anchor pins have been used?

Very truly yours,

FRANK M. WILLIAMS,
State Engineer

By _____
Assistant Deputy.

130

391 Rocks.

James P. Brownell
M. Am. Soc. C.E.
Civil and Hydraulic Engineer
Carthage, New York

July 19, 1922.

Frank M. Williams
State Engineer
Albany, N.Y.

Dear Sir:

Enclosed find cross-sections of rock on which the dam at Browns Falls on The Oswegatchie River, for the Northern New York Utilities, Inc. is to be founded. The sections show the foundation as it has been prepared and we are adding anchor pins 2" in diameter at about one foot intervals, where the rock is not decidedly rough or sloped in our favor.

The sections sent are those stripped and prepared for foundations. The remainder of sections will be sent as soon as ready.

Yours respectfully,

JPB:BS

James P. Brownell

STATE OF NEW YORK
DEPARTMENT OF STATE ENGINEER AND SURVEYOR
TESTING LABORATORY
ALBANY

Tests of Sand from Northern N.Y. Utilities Co. at Watertown N. Y.,
for use on ~~Contract No. Island at Barnes Falls, Champlain Canal~~, Champlain Canal, Middle Division.
~~Contract~~ Sample No. 140 taken ; received at Laboratory June 19; made up June 20
Sand is composed of fine grains of disintegrated Precambrian granite.

Percentage of Voids 30.1; Loam ; Organic matter —
Parts of sand to cement by weight / bulk :— 2½ sand to 1 cement. Per cent water used ±12
Temperature of water used in mixing 70 Fahr. Briquettes kept in moist air 24 hours and then immersed.
Cement used in tests Standard Blend This cement tested as follows:—
Sets (determined by Vicat needle):—Initial, { in 8.5 min. / Minim. requirement 45 min. }; hard, { in 4.10 min. / Max. requirement 600 min. }
Constancy of Volume Tests:—Normal air Good: Normal water Good; Accelerated Good
Fineness (per cent passing standard sieve No. 100) 98.0 (Requirement, 92%)
" (" " " " " No. 200) 83.7 (Requirement, 78%)

TENSILE STRENGTH IN POUNDS PER SQUARE INCH						SIZE OF SAND	
STANDARD SAND		NATURAL SAND		WASHED SAND		PASSING SIEVE	
7 Days	28 Days	7 Days	28 Days	7 Days	28 Days	No.	Per Cent
232		184				4	100.0
258		169				6	100.0
231		179				10	96.0
202		195				20	76.2
248		188				30	64.0
1171		915				40	37.6
234		183				60	18.0
						74	12.2
						100	5.0
						140	2.2
						200	1.0

Remarks:

I CERTIFY *that this is a true abstract taken from the records of tests* June 28 1927

Russell S. Greenman
Sr. Ass't Engineer in Charge of Tests

STATE OF NEW YORK
DEPARTMENT OF STATE ENGINEER AND SURVEYOR
SENIOR ASSISTANT ENGINEER'S OFFICE
Testing Laboratory
State Engineer's Dep't
Albany, N. Y.

SUBJECT:

June 28, 1922.

MEMORANDUM ON SAMPLE OF SAND FROM NORTHERN N.Y. UTILITIES, Inc., FOR USE ON DAM AT BROWN'S FALLS, OSWEGATCHIE RIVER.

(Attention of Mr. Mc Kim)

The results of the tests and examination of this sample of sand show it to be a fine-grained sand that is clean and fairly well-graded and that gives a fair strength test for a sand of this type.

It should give good results in use but could be improved if it had more coarse grains.

R. S. [illegible]

Sen. Asst. [illegible]
in charge [illegible]

MEMORANDUM FOR R. G. FINCH, DEPUTY STATE ENGINEER,
RELATIVE TO DAM NO. 391, OSWEGATCHIE WATERSHED,
NEWTON FALLS.

On June 13, I inspected with the owner's engineer, James P. Brownell, Dam No. 391, Oswegatchie watershed on Oswegatchie river below Newton Falls, owned by the Northern New York Utilities, Inc., of watertown.
cw

The present concrete dam is built entirely upon granite ledge. The spillway top has two grooves left for binding 10" wide by 4" deep and between a third groove 6" wide at present filled by a wooden strip. The downstream side is stepped with projecting stones for binding. The concrete of the spillway is in good condition.

The non-overflow wall on the south side of the present spillway is in fair condition, except for some laitance on top which I recommended to have picked off.

The top surface of the non-overflow part on the north of the present spillway is somewhat cracked because it was too rich in cement. I recommended to have this cracked part entirely picked clean.

The shore south of the present dam from Station 6 to 4+75 is entirely stripped for the new dam and the bed is composed of granite ledge with good shoulders for shear. Beyond this to Station 0 there are numerous outcroppings of granite ledge and probably this ledge extends under the whole of the proposed dam on the south shore.

On the shore north of the present dam the granite ledge is about 38 ft. below the proposed spillway crest and probably does not run very much higher in the bank. This bank has not been stripped at all. On top of the bank, which is about 50 ft. above the proposed spillway crest, two test pits have been excavated; one test pit is 6 ft. deep and the other is 15 ft. deep. The soil from these two test pits is a very sandy red clay with no large stone and appears to be impervious. I recommended that the excavations be made no wider than necessary for the walls and to have the excavations entirely filled with concrete.

Inspector of Docks and Dams.

June 21, 1922.

ARMcK-F.

June 19, 1922.

Dam No. 391 Oswegatchie
Watershed

Mr. James P. Brownell,
Carthage, N. Y.

Dear Sir:

Our inspector, Mr. McKim, on June 15, inspected Dam No. 391, Oswegatchie Watershed on Oswegatchie river at Newton Falls, owned by the Northern New York Utilities, Inc., of Watertown.

He reports that the present dam is built entirely upon granite ledge. The spillway top has two grooves left for binding 10" wide by 4" deep and between a third groove 6" wide at present filled by a wooden strip. The downstream side is stepped with projecting stones for binding. The concrete of the spillway is in good condition.

The non-overflow wall on the south side of the spillway is in fair condition, except for a laitance on top which it is proposed to have picked off.

The top surface of the non-overflow part on the north of the spillway is somewhat cracked because it was too rich in cement. It is intended to have this cracked part entirely picked clean.

The south shore of the present dam from Station 6 to 4+75 is entirely stripped for the new dam and the bed is composed of granite ledge with good shoulders for shear. Beyond this to Station 0 there are numerous outcroppings of granite ledge and probably this ledge extends under the whole of the proposed dam on the south shore.

On the north shore the granite ledge is about 38 ft. below the proposed spillway crest and probably does not run very much higher in the bank. This bank has not been stripped at all. On top of the bank two test pits have been excavated 50 ft. above the proposed spillway crest; one test pit is 6 ft. deep and the other is 13 ft. deep.

Mr. J. P. B. #2 6/19/22.

The soil from these two test pits is a very sandy red clay with no large stone and appears to be impervious. It is intended to make the excavations no wider than necessary for the walls and to have the excavations entirely filled with concrete.

Very truly yours,

FRANK M. WILLIAMS,
State Engineer

By_____
Deputy State Engineer.

ARMcK-F.

June 10, 1922.

Dam 391, Oswegatchie

Mr. James P. Brownell,
Carthage, N. Y.

Dear Sir:

We have received your letter of June 9th. Our inspector, Mr. McKim, will be in Watertown Monday night and expects to inspect the Browns Falls dam on Tuesday. He will phone you from Watertown as regards arrangements for reaching the dam.

Very truly yours,

FRANK M. WILLIAMS,
State Engineer,

By_____
Assistant Deputy.

James P. Brownell
M. Am. Soc. C.E.
Civil and Hydraulic Engineer
Carthage, New York

June 9, 1922.

Frank M. Williams
State Engineer & Surveyor
Albany, N.Y.

Dam No. 391, Oswegatchie
Newton Falls

Dear Sir:-

In reply to your letter of June 7th, 1922, regarding the above subject.

The dam #390 and water power is now owned by the Northern New York Utilities, Inc. It will be abandoned as soon as the new development is in operation. The Northern New York Utilities own all the water rights from Newton Falls down the river to a point about one-half mile below Skate Creek (see Geological Sheet) which comprises all the head (267 feet) now under development, together with an undeveloped power at Flat Rock of about 62 feet, and which they intend to construct in a few years. This Flat Rock Power is located just below Skate Creek outlet, and will flood back to the tail race of the Browns Falls Plant under construction, the flow line to be elevation 1080.

The sand which you requested for testing, will be sent next week.

We are cross-sectioning the dam site, as soon as stripped, every 5 feet. These sections are to be plotted on standard cross-section paper 16x20, for purpose of computing areas and for our records. They will show the shape and bottom of the rock or other material on which the dam is to be founded, as well as the earth surface. They will not show the roughness as much as it exists, for much of the roughness which will serve as means to prevent sliding would be averaged in taking measurements for quantity. Would Blue Prints of these sections meet the requirements that you ask for? I would suggest that when your inspector arrives that he take particular notice of this roughness, which really cannot be expressed in drawings, and then he might better be able to tell us the best means of furnishing the information you desire, and which will be understood when it reaches Albany.

The river bed is now bare, the water being taken through the old sluices. The portion between 4+62 and 6+00 is being stripped, and will be all uncovered by the time an inspector could arrive. I think an inspection now, before any forms are set, would give your inspector the best means of seeing the large sections. Then as soon as the remaining portion of the dam is stripped, I will notify you.

Yours respectfully,

JPB:BS

James B Bonnell

NORTHERN NEW YORK UTILITIES INC.
SUCCESSORS TO
WATERTOWN LIGHT AND POWER COMPANY
CARTHAGE ELECTRIC LIGHT AND POWER COMPANY
DEXTER ELECTRIC LIGHT AND POWER COMPANY
THOUSAND ISLAND ELECTRIC LIGHT AND POWER COMPANY

WATERTOWN, NEW YORK June 8, 1922.

re McKinn

State Engineer,

Albany, N. Y.

Dear Sir:-

We are in receipt of yours of June 6th granting permission for dam No. 391 in the Town of Fine near the Villages of Oswegatchie and Newton Falls, and are proceeding with the work in accordance with this permission.

We wish to thank you for the promptness with which you have handled this, and I am requesting that our engineer report to you as to the character of material, etc. We expect to start work on this dam at once.

Very truly yours,

NORTHERN NEW YORK UTILITIES INC.

H. G. Rowe

Gen. Manager Electrical Dept.

HGD/B

140

ARMcK-F.

June 6, 1922.

Dam No. 391, Oswegatchie,
Newton Falls

Northern New York Utilities, Inc.,
Watertown, N. Y.

Gentlemen:

We have received from your engineer, Mr. James P. Brownell, in duplicate application, report and six blue prints, Nos. 42101, 42201 (2 sheets), 42206 (2 sheets) and 42207, for the reconstruction of Dam No. 391, Oswegatchie Watershed below Newton Falls, (Browns Falls).

The construction of the above dam is approved in so far as the matter involves the jurisdiction conferred upon this office by Chapter LXV of the Consolidated Laws, Chapter 647, Laws of 1911, Section 22, and permission is given for the construction of this work up to November 1, 1923. This approval shall not be deemed to authorize any invasion of property rights, either public or private, in carrying out the above work; nor to create any claim against the State of New York; nor to be considered as authorizing the flooding of State lands, nor as acquiescing in the flooding of such lands.

If flashboards are to be used in the spillway, they should be so designed as to give way entirely when the pond level reaches two-thirds the depth of the spill so that the whole spillway may be available for floods. The design of these flashboards, giving the span of the supports and dimensions of parts, should be submitted to and approved by this office before they are used.

We require a record from your engineer upon each section of the bed and banks as soon as excavated concerning the character of the material; the hardness and perviousness; the roughness and shoulders to resist shear, and the proposed provisions against sliding and under seepage.

Please acknowledge the receipt of this letter and advise us when you start the above work.

Very truly yours,

FRANK M. WILLIAMS,
State Engineer

Copy to-
Mr. James P.Brownell.

By_____
Deputy State Engineer.

ARMcK-F.

June 7, 1922.

Dam No. 391, Oswegatchie,
Newton Falls

Mr. James P. Brownell,
Strickland Building,
Carthage, N. Y.

Dear Sir:

We have received your letter of June 1, 1922, concerning dam No. 391, Oswegatchie Watershed below Newton Falls, and enclose a copy of a letter of approval forwarded to the owner, the Northern New York Utilities, Inc., Watertown, N. Y., together with a duplicate set of six prints Nos. 42101, 42201 (2 sheets), 42206(2 sheets) and 42207 stamped with our approval and duplicate application and report.

Some distance below the above dam there is a log crib dam, our No. 390, Oswegatchie Watershed. Has this dam also been acquired by the Northern New York Utilities, Inc. and will it be done away with when dam No. 391, Oswegatchie is reconstructed? If not, for what purposes will dam No. 390, Oswegatchie be used? What is the distance above the roadway to this dam?

We enclose also shipping tag No. 140 in order that you may ship to our laboratory for testing 1/2 cubic foot of sand to be used in the construction of the above dam.

Very truly yours,

FRANK M. WILLIAMS,
State Engineer

By_____
Assistant Deputy

Enclosures.

ALEXANDER MACDONALD
COMMISSIONER

C. TRACEY STAGG
DEPUTY COMMISSIONER

HERBERT F. PRESCOTT
SECRETARY

STATE OF NEW YORK

DIVISION OF FISH AND GAME
LLEWELLYN LEGGE, CHIEF
DIVISION OF LAND AND FORESTS
C. R. PETTIS, SUPERINTENDENT
DIVISION OF SARATOGA SPRINGS
J. G. JONES, SUPERINTENDENT
SARATOGA SPRINGS, N. Y.

CONSERVATION COMMISSION

IN REPLYING PLEASE REFER TO FILE NO.

ALBANY June 8th 1922.

Hon. Frank M. Williams,
State Engineer,
Albany, N. Y.

Dear Sir;- Attention Chas. R. Waters, Asst. Deputy.

In reply to your letter of June 6th stating that the Northern New York Utilities Co. wish to increase the height of a dam near Newton Falls, and asking if the dam will require a fishway, I beg to advise that this Commission will not require a fishway to be placed in the said dam at this time.

Yours very truly,

ALEXANDER MACDONALD - COMMISSIONER,

By Llewellyn Legge

LL/MG. Chief, D. F. G. C. C.

ARMcK-F.

June 6, 1922.

Dam 391, Oswegatchie,
Newton Falls

Hon. Alexander Macdonald,
Conservation Commissioner,
Albany, N.Y.

Dear Sir:

The Northern New York Utilities Company wishes to increase dam No. 391, Oswegatchie, three miles below Newton Falls from a height of 20 ft. to a height of 65 ft. by 900 ft. long, the dam to be of concrete. This dam is located on U. S. G. S. Sheet 124 just north of Benson Mines and is marked "Browns Falls Power Plant" upon the map. Will this dam require a fishway?

Very truly yours,

FRANK M. WILLIAMS,
State Engineer

By_____
Assistant Deputy.

re McKim

James P. Brownell
M. Am. Soc. C.E.
Civil and Hydraulic Engineer
Carthage, New York

June 1, 1922.

Mr. Frank M. Williams
State Engineer & Surveyor
Albany, N.Y.

Dear Sir:-

Enclosed find application together with report for permission to build a concrete dam at Browns Falls on the Oswegatchie River, in the town of Clifton, St. Lawrence County, N.Y. Also under another cover, we are mailing blue prints covering such matter as you may require.

The river bed is bare, and by the time your inspector can reach here, the rock between Station 4 and 6 will be stripped I would very much like to have an inspector at once.

The remaining portion of the site will not be uncovered much before the first of July, at which time I will again notify you.

Yours very respectfully,

JPB:BS

James P. Brownell

AHMcK-F.

April 6, 1928.

Mr. James P. Brownell,
Strickland Building,
Carthage, N. Y.

Dear Sir:

We enclose revised application forms for dams. Please fill out completely one application for each dam, sign on the last page and submit for approval before commencing work.

Very truly yours,

FRANK M. WILLIAMS,
State Engineer

By_____
Chief Clerk.

Enclosures.

ARMcK-P.

March 2, 1922.

Mr. James P. Brownell,
Strickland Building,
Carthage, N. Y.

Dear Sir:

The New York Water Power Commission has jurisdiction only over power developments which are built upon or which flood State lands.

We believe the Northern New York Utilities, Inc., now own the two dams at Browns Falls on the Oswegatchie river. Both dams were formerly owned by the Benson Mines Company.

Is the proposed development the reconstruction of the upper concrete dam built in 1915, or of the timber dam below? What is the distance of these two dams from the highway crossing just below them and from the Clifton-Fine township line?

We enclose an application blank for you to fill out and return.

Very truly yours,

FRANK M. WILLIAMS,
State Engineer

By_____
Chief Clerk.

Enclosure.

James P. Brownell
M. Am. Soc. C.E.
Civil and Hydraulic Engineer
Carthage, New York

E 124
390 n1 Ohio

February 28, 1922

Mr. Alex. Rice McKim,
c/o State Engineer's Office
Albany, N.Y.

Dear Sir:-

I am wondering if the methods of submitting our plans etc., for hydroelectric development have changed any since your department has been transferred to the State Engineer's Office.

I am providing for our Browns Falls Plant

1- Map of Pond to be flowed

2- Plan of Dam

3- Sections

4- Strain Diagram

5- Plans of Gate Houses, trash racks, etc.

Do I have to secure any consent other than for the Dam orIntake ? I do not know what this Water Power Commission is. Do I have to go before them also with plans, etc.? If so, whom should I address?

Excuse me for troubling you but you are the only person from Albany who gets in direct touch with us.

Yours very respectfully,

JPB/BS

James P. Brownell

ARMcK-P.

February 1, 1922.

Mr. James P. Brownell,
Strickland Building,
Carthage, N. Y.

Dear Sir:-

Your letter of January 30 received, concerning the reconstruction of Browns Falls dam. We enclose application blanks as requested.

Under separate cover we are sending you Volume II of the State Engineer's Report for 1919. The 1920 report is now in the hands of the printer, and a copy will be sent to you as soon as we receive our supply.

Very truly yours,

FRANK M. WILLIAMS,
State Engineer

By_____
Chief Clerk.

Enclosure.

ARMcK-F.

February 1, 1922.

Mr. James P. Brownell,
Strickland Building,
Carthage, N. Y.

Dear Sir:-

Your letter of January 30 received, concerning the reconstruction of Browns Falls dam. We enclose application blanks as requested.

Under separate cover we are sending you Volume II of the State Engineer's *Report* for 1919. The 1920 report is now in the hands of the printer, and a copy will be sent to you as soon as we receive our supply.

Very truly yours,

FRANK M. WILLIAMS,
State Engineer

By_____
Chief Clerk.

Enclosure.

May 17, 1918.

Mr. Carl P. Birkinbine,
Parkway Building,
Philadelphia, Pa.

Dear Sir:-

Answering yours of the 14th inst. in relation to height of core wall in the dam across Oswegatchie River, we shall set no arbitrary limiting height to an earth dam with a core wall. Providing your proposed plans conform to current engineering practice and are based upon sound conservative engineering principles, you will have no difficulty in securing the approval of this Commission.

Yours truly,

GEORGE D. PRATT, Commissioner,

By,

_____

AHP/F

DIVISION ENGINEER.

BIRKINBINE
ENGINEERING OFFICES,
PARKWAY BUILDING,
Broad and Cherry Streets,
PHILADELPHIA.

JOHN L. W. BIRKINBINE
CARL P. BIRKINBINE
P. L. BITLER

May 14, 1918.

[Benson Mines Dam

Conservation Commission,
State of New York,
Albany, New York.

Gentlemen:--

In the winter of 1913 to 1914 we constructed on the Oswegatchie River a dam of the stepped type, so that it could later be carried up to a greater height. At the owner's request we have taken up this matter and made preliminary studies. On the right bank of the river there is considerable over-burden above the rock at the end of the present dam, and this naturally suggests that the cheapest form of dam at this end would be a core-wall. Considering that the core-wall would be built with a batter on each side and carried in earth up to and frequently above its top, we write to inquire your views as to the approximate height to which your Department would permit the construction of such a core-wall. You will understand that we are not asking your Engineering Department to specify definitely any limit, but we are anxious to obtain their views so that we can complete our estimates and studies.

Of course if we are instructed to go ahead the suggested design will be taken up in detail with your Engineering Department and approval asked for, as was done in the previous case, and as is required by the laws of the State of New York.

Very truly yours,

BIRKINBINE ENGINEERING OFFICES,

By Carl P. Birkinbine

CPB:MB

315
341
~~481~~
~~474~~

June 22, 1914.

Mr. Lou B. Cleveland,

Cleveland Bldg.,

Watertown, N. Y.

Dear Sir:-

Your letter of June 16th concerning dam #391 Oswegatchie River Watershed, owned by the Benson Mines Company, received.

The first application for this dam was filed September 26, 1913 and was approved by the Commission on October 14, 1913. The supplemental application was filed December 1, 1913 and approved by the Commission December 3, 1913.

Very truly yours,

Conservation Commission,

By

Commissioner.

McK/C.

LOU B. CLEVELAND
CIVIL ENGINEER AND CONTRACTOR
CLEVELAND BUILDING
WATERTOWN, N.Y.

Personal.

June 16, 1914.

Mr. A. R. McKim,

Conservation Commission,

Albany, N. Y.

My dear Mr. McKim:-

Can you advise the date the Benson Mines Co. first took up the matter of approval of plans for their dam at Oswegatchie, N. Y., when these plans were changed and when the revised plans were finally accepted by you.

I have not had the pleasure of seeing you in Watertown for sometime and trust the next time you are up here you will have the time to drop in and see me.

With best personal regards, I am

Yours truly,

Lou B. Cleveland

LBC-B

150

February 21, 1914.

Benson Mines Co.,

Benson Mines, N. Y.

Gentlemen:-

Kindly inform us whether you are the owners of what was known as Jenny's Mills just back of the Town of Oswegatchie, which mill was abandoned but connected with which was a dam and mill pond. If you are the owners, kindly inform us if there is any water impounded by this dam. My impression is that this dam was on the Little River or a tributary thereto.

Very truly yours,

Conservation Commission,

By

Commissioner.

McK/C.

PHILADELPHIA OFFICE
1410 REAL ESTATE TRUST BLDG.

RECEIVED
DEC 9 1913
DIVISION INLAND WATERS
Chief Engineer

COMR MOORE

Benson Mines Company

Benson Mines, St. Lawrence County, N.Y.

Benson Mines, N.Y.
December 8, 1913.

Referred to Inspector McKim

Conservation Commission,
Albany, N.Y.

Gentlemen:

We are in receipt of yours of the 4th together with approved blue print, serial 141, of dam 391 Oswegatchie, also copy of resolution passed by your Commission.

We are obliged for your prompt action in this matter, and I wish to express my appreciation of the courtesies shown me when in Albany, which facilitated my work there.

Very truly yours

Benson Mines Company

Engineer

CPB/B

1411

Dec. 4, 1913.

Benson Mines Co.,

Benson Mines, N. Y.

Gentlemen:-

Enclosed you will find blue print of dam known in our records as #391 Oswegatchie River Watershed, and by Serial #124, supplemented by Serial #141, said blue print and this letter applying to #141.

Upon the plan you will find a certificate signed by the Secretary to the Commission stating that by a duly adopted resolution your plan has been approved in accordance with the provisions of Section 22 of the Conservation Law.

You will also find enclosed copy of the resolution, which please read carefully and acknowledge receipt.

Yours truly,

Conservation Commission,

RWS/F

Secretary to Commission.

150

Nov. 26, 1913.

Benson Mines Co.,

Benson Mines, N. Y.

Gentlemen:-

Since your Engineer, Mr. Berkinbine, called here on the 24th inst. we have received your blue print drawings, your Nos. 516, 517 and 518. These pertain to the changes in the location, etc., of the outlets through your dam now under construction in the Oswegatchie River, known in Conservation Commission records as Serial #124, Dam #391, Oswegatchie Watershed.

We desire that your blue prints show by dotted lines, or in some distinct way, the location of the outlets as shown on the plans already approved by this Commission; also the usual blank white space for our approval stamp. We should also have from you a written communication making application for approval of the changes which you desire, and setting forth the reasons therefor.

Waiting to hear further from you on the lines above indicated, we remain,

Yours truly,

Conservation Commission,

R W Sherman

RWS/F

Chief Engineer.

November 15, 1913.

Concerning the Sand, sample No.
18 for Dam #391 Oswegatchie Watershed.

Benson Mines Co.,

Benson Mines, N. Y.

Gentlemen:-

Forty-three and eight tenths per cent of the sample was sand composed of coarse granite grains and fine grains of quartz and feldspar. The percentage of voids was 35.5; loam 2.2. On an average of five tests of three of sand to one of cement for seven days the result was 152 pounds per square inch. The standard quartz sand averaged 202 pounds per square inch, which result is only fair. The initial set was in 180 minutes and hard in 303 minutes. Tested with the sieves the sand was well graded.

Very truly yours,

Conservation Commission,

By

Commissioner.

McK/C.

STATE OF NEW YORK
DEPARTMENT OF STATE ENGINEER AND SURVEYOR
TESTING LABORATORY
ALBANY

Tests of Sand from Conservation Co's at Benson Mines N. Y.,
for use on Contract No. Sec. No. Barrins Falls Oswegatchie River Division.
~~Contract~~ Sample No. 18. taken ; received at Laboratory ; made up Oct. 29.
Sand is Bank Gravel — 43.8% being sand. Sand is composed of coarse granitic grains and fine grains of quartz and feldspar.
Percentage of Voids 35.1 ; Loam 2.2 ; Organic matter —
Parts of sand to cement by ~~weight~~ bulk :— 3 sand to 1 cement. Per cent water used ± 10%
Temperature of water used in mixing 62 Fahr. Briquettes kept in moist air 24 hours and then immersed.
Cement used in tests Standard Cement. This cement tested as follows:—
Sets (determined by Vicat needle):—Initial, {in 180 min. (Minim. requirement, 30 min.)}; hard, {in 550 min. (Requirement, 60 to 600 min.)}
Constancy of Volume Tests:—Normal air Good; Normal water Good; Accelerated Good
Fineness (per cent passing sieve of 2,500 meshes per square inch) 99.6 (Requirement, 99%)
" (" " " " 10,000 " " " ") 95.4 (Requirement, 92%)

TENSILE STRENGTH IN POUNDS PER SQUARE INCH						SIZE OF SAND	
STANDARD QUARTZ SAND		NATURAL SAND		WASHED SAND		PASSING SIEVE	
7 Days	28 Days	7 Days	28 Days	7 Days	28 Days	No.	Per Cent
212	534	146				2	—
205	345	160				4	—
200	326	155				6(?)	100.0
217	310	152				10	60.2
192	310	148				20	24.4
1026	1625	761				30	16.8
205	325	152				40	9.2
						60	7.8
						74	2.4
						100	2.0
						140	1.2
						200	0.8

Remarks:

I CERTIFY *that this is a true abstract taken from the records of tests* Nov. 5. 1903

Russell S. Greenman
Resident Engineer in Charge of Tests

391

October 21st, 1913.

Benson Mines Company,

Benson Mines, N. Y.

Gentlemen:-

Following is the report of sand, Serial No. 17, received at the laboratory October 8th.

This sand is composed of coarse granite grains and fine quartz grains with some feldspar. Percentage of voids - 33.5, loam- a trace. The average of five tests of three parts of sand to one part of cement with standard quartz sand is 205 pounds per square inch; whereas with your sand unwashed the average of five tests is 210 pounds per square inch. These tests give a most admirable result and the sand seems to be thoroughly well graded in size. The sand used in the above tests was screened from the gravel, being 23.5 per cent of the gravel sample. Other tests were made on sand sample. Cement sufficient should be used to fill these voids which would be about one to eight on the aggregate.

Yours truly,

CONSERVATION COMMISSION,

By

Inspector of Docks and Dams.

At Albany Tuesdays.

McK/H.

160

REPORT OF TESTS FOR BARGE CANAL

STATE OF NEW YORK
DEPARTMENT OF STATE ENGINEER AND SURVEYOR
TESTING LABORATORY
ALBANY

Tests of Sand from Conservation Co. at Binary Mines N. Y.,
for use on Contract ~~No.~~, Res. No. , ~~Canal~~, ~~Division~~.
Contract Sample No. 17 taken ; received at Laboratory Oct 8 ; made up Oct. 9.
Sand is composed of coarse granite grains and fine quartz grains with some feldspar
Percentage of Voids 33.5 ; Loam Trace ; Organic matter —
Parts of sand to cement by ~~weight~~ bulk :— 3 sand to 1 cement. Per cent water used ± 10
Temperature of water used in mixing 72 Fahr. Briquettes kept in moist air 24 hours and then immersed.
Cement used in tests Standard Cement. This cement tested as follows:—
Sets (determined by Vicat needle):—Initial, {in 180 min. / (Minim. requirement, 30 min.)} ; hard, {in 330 min. / (Requirement, 60 to 600 min.)}
Constancy of Volume Tests:—Normal air Good ; Normal water Good ; Accelerated Good
Fineness (per cent passing sieve of 2,500 meshes per square inch) 99.6 (Requirement, 99%)
" (" " " " 10,000 " " " ") 95.4 (Requirement, 92%)

TENSILE STRENGTH IN POUNDS PER SQUARE INCH						SIZE OF SAND	
STANDARD QUARTZ SAND		NATURAL SAND		WASHED SAND		PASSING SIEVE	
7 Days	28 Days	7 Days	28 Days	7 Days	28 Days	No.	Per Cent
212	334	220				4	100.0
205	345	205				4	98.4
200	326	200				6 (1/8")	92.8
217	310	216				10	92.4
192	310	210				20	77.8
1026	1625	1051				30	50.6
205	325	210				40	22.6
						60	10.2
						70	3.2
						100	1.6
						140	1.0
						200	0.8

Remarks: Sand used in tensile strength test was screened from gravel, being 23.5% of gravel sample. Other tests were made on sand sample.

I CERTIFY *that this is a true abstract taken from the records of tests* Oct. 16. 19 13

Russell S. Greenman
Resident Engineer in Charge of Tests

PHILADELPHIA OFFICE
1410 REAL ESTATE TRUST BLDG.

RECEIVED
OCT 1913
DIVISION INLAND WATER
Chief Engineer

CONSERVATION COMMISSION
CH. ENGR. SHERMAN
RECEIVED

Benson Mines Company

Benson Mines, St. Lawrence County, N.Y. October, 22, 1913.

391 Oswegatchie

Mr. Albert S. Hoyt, Secy.,
Conservation Commission,
Albany, N.Y.

No Reply

Dear Sir:-

We received your favor of the 15th., inst, enclosing blue prints of the dam we are to construct on the Oswegatchie River with the Commission's approval stamped on same.

In some way your letter was mislaid, and not answered acknowledging same till this late day. Hoping you will forgive us for delaying acknowledging same, and thanking you , we remain

Yours very truly,

O J Conley

Manager.

OJC/L.

Oct. 15, 1913.

Benson Mines Company,

Benson Mines, N. Y.

Gentlemen:-

Enclosed you will find blue prints of plan for dam, known in our records as Serial #124, Dam #391 Oswegatchie Watershed. Upon the plans you will find a certificate signed by the Secretary to the Commission stating that by a duly adopted resolution of the Commission your plans and specifications have been approved in accordance with the provisions of Section 22 of the Conservation Law.

You will also find enclosed copy of the resolution which please read carefully and acknowledge receipt.

Yours very truly,

Conservation Commission,

By

RWS/F

Secretary to Commission.

WHEREAS, the Benson Mines Company having an office at Benson Mines, N. Y., did on the sixth day of October, 1913, submit plans and specifications for the construction of a dam in the East Branch of the Oswegatchie River, in the Town of Clifton, County of St. Lawrence, said dam being known in Conservation Commission records as Dam #391, Oswegatchie Watershed; and did by Conservation Commission Serial #194 make application for the approval of said plans and specifications under the provisions of the Conservation Law, and

WHEREAS, said plans and specifications have been approved by the Chief Engineer and the Inspector of Docks & Dams, and said plans signed by them respectively, now therefore be it

RESOLVED, that said plans and specifications be and hereby are approved; provided, however, that this resolution shall not be deemed to authorize any invasion of any property rights, public or private, by any person in carrying out the requirements of this resolution, nor to create any claim or demand against the State of New York.

WHEREAS, on the 14th day of October, 1913, this Commission by resolution approved plans and specifications submitted by the Benson Mines Company as owner for a dam known in Conservation Commission records as Serial #124, Dam #391 Oswegatchie River Watershed, and

WHEREAS, the Benson Mines Company did on the 1st day of December, 1913, submit a supplemental plan showing by dotted lines thereon an increase in the height or flow line elevation of 2 ft. over that shown on the plans approved as aforesaid (the specifications remaining as approved), and did by Serial #141 make application for the approval of said supplemental plan under the provisions of the Conservation Law, and

WHEREAS, said plans and specifications have been approved by the Chief Engineer and the Inspector of Docks & Dams, and said plans signed by them respectively,

NOW, THEREFORE, BE IT RESOLVED, that said plans and specifications be and hereby are approved, provided however that this resolution shall not be deemed to authorize any invasion of any property rights, public or private, by any person in carrying out the requirements of this resolution, nor to create any claim or demand against the State of New York.

Form No. IW88. 11-1-19-1000 (10-781)

Dam No. 391 Oswegatchie

STATE OF NEW YORK

CONSERVATION COMMISSION
ALBANY

Oct 6 1913

Albany, N. Y.

Serial No. 124

Application filed Sept 26th 1913

Approved by Commission Dec 14th 1913

Material Tag No.

Foundations inspected

Final inspection

This application for the construction of a dam has been examined by C R Pettis of the Conservation Commission, and we find that the proposed dam will not cause the flooding of any part of the

C. R. Pettis

APPLICATION FOR CONSTRUCTION OR RECONSTRUCTION OF A DAM

Benson Mines, N. Y.
(Address of Applicant)

Application is hereby made to the Conservation Commission of the State of New York, in compliance with the provisions of Chap. LXV of the Consolidated Laws, the Conservation Law, for approval of the detailed specifications and plans, marked Beason Mines Co. Benson Mines, N.Y. Proposed Dam on Oswegatchie River Nos. 5000, 5001, 5002, 5003 & 5004 herewith submitted, for the { construction / ~~reconstruction~~ } of the dam herein described. All provisions of law will be complied with in the erection of the said dam, whether specified herein or not.

Sept. 24, 1913
(Date)

{ Signature of Applicant } Benson Mine Co

O J Conley
Manager

LOCATION AND GENERAL DATA

Site of dam is on East Branch at the Oswegatchie River
(Name of stream)

a branch of The Oswegatchie River, within the
(Name of stream)

limits of the town of Clifton, County of St. Lawrence

3000 Ft. Upstream from the Benson Mines Co's present hydro-electric plant known as Benson's Falls
(Give approximate distance from well-known bridge, dam, village or mouth of stream, so that work can be located on map of state)

and 1/2 Mile west of the Old Albany Road Ford and 2 3/4 Miles N.E. in air line from the

Oswegatchie R.R. station. Site is near Township Line of Clifton & Fine.

Purpose of dam to store water for the Hydro electric plant
to furnish power

necessary to operate the concentrating plant at Benson Mines.

Reasons for making changes in existing structure

DATA AND DIMENSIONS

General:

Materials of which dam is to be constructed Concrete - 1-2-4 mixture:
Edison Cement, Sand as per sample, Gravel screened
and broken rock (Gneiss and Granite)

Area of watershed above dam Between 150 & 200 square miles.

Area of water surface of pond at level of spillway crest 34 1/2 (Thirty-four & one-half) acres.

Capacity of reservoir (at above level) 10,000,000 (Ten Millions.) cubic feet.

Length of spillway crest 150 (One hundred and Fifty) feet.

Maximum depth of water on spillway crest 8 (Eight). feet.

Maximum discharging capacity of spillway 12,250 cubic feet per second.

Maximum discharging capacity of spillway per square mile of drainage area
between 82 and 61 (Eighty-one & Sixty-one) cubic feet per second.

Masonry or timber portion:/

Length on top ..... Two hundred and Eighty five (285) ..... feet.

Length in stream bed ..... Fifty (50) ..... feet.

Maximum height above stream bed ..... Thirty two and one half (32½) ..... feet.

Maximum height above foundation bed ..... Thirty-three and one half (33½) ..... feet.

Maximum width of base ..... 26'-6" for bulkhead and 31'-0" for Rollway ..... feet.

Maximum width of top ..... 4'-0" for bulk head ..... feet.

Elevation of top above maximum water level in pond ..... feet.

Elevation of top above spillway crest ..... Eight (8) ..... feet.

Nature of foundations ..... Solid Gneiss .....

Earth portion:

Embankment:

Length on top ..... feet.

Length in stream bed ..... Z ..... feet.

Maximum height above stream bed ..... O ..... feet.

Maximum width of base ..... feet.

Maximum width of top ..... Z ..... feet.

Elevation of top above maximum water level in pond ..... feet.

Elevation of top above spillway crest ..... feet.

Slope, upstream face .....

Slope, downstream face .....

Core wall:

Material .....

Elevation of top above spillway crest ..... Z ..... feet.

Width of top ..... O ..... feet.

Batter of faces .....

Maximum height above foundations ..... feet.

Maximum width of base ..... feet.

Sheeting or other cut-off If warranted a cut-off wall will be placed on Upstream Face

Is fishway provided? There are no fish in the stream.

General description of regulating works, gate houses, outlet pipes, penstocks, forebays, canals, flashboards, gates, log chutes, etc.

Two 5'-6" x 5'-6" Sluice Gates discharging into river bed, also two 6'-0" x 10'-0" pentrol control Gates with gate hoists, trash racks,

Names of owners of property which will be submerged by construction of dam, with approximate submerged area owned by each.

All is Benson Mines Co's. property.

It is intended to complete work covered by this application by As much as advisable before cold weather, say Dec. 1st 1913
(Date)

REPORT UPON APPLICATION

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany Oct 6th 1913

I have carefully examined the plans of the above dam, and find that if the work is constructed in accordance with the plans, filed Sept 26th 1913 with good workmanship and the specified materials that it will be safe.

Approved:

R. H. Thomson
Chief Engineer.

Alex Rice McKim
Inspector of Docks and Dams.

APPROVAL BY COMMISSION

STATE OF NEW YORK

CONSERVATION COMMISSION

ALBANY

On Oct. 14 1913 the Conservation Commission, by resolution duly adopted, approved of the above application for the { construction / ~~reconstruction~~ } of dam 391 Oswegatchie on East Branch of Oswegatchie River and hereby gives permission for the { construction / ~~reconstruction~~ } of said dam within 18 months from date in accordance with the specifications and plans, and subject before erection to the approval by the Inspector of the materials of construction and of the foundation bed when stripped and prepared, and subject to the inspection of the work during and after construction. This approval may be amended if deemed necessary to secure a safe structure.

(Seal)

.....
Secretary to Commission.

REPORT ON INSPECTION OF FOUNDATION

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany.....

Work on the above dam was started....., contracts for the same having been awarded to.....

.....

On .....

.....

.....

.....

Approved:

.....
Inspector of Docks and Dams.

.....
Chief Engineer.

REPORT ON COMPLETION OF WORK

CONSERVATION COMMISSION — DIVISION OF INLAND WATERS

Albany.....

On.....I inspected the above work and found that it had been completed in a satisfactory manner.

Approved: .....

Inspector of Docks and Dams.

.....

Chief Engineer.

INSTRUCTIONS TO APPLICANTS

Requirements for Plans.—Before beginning the construction, reconstruction, alteration or extension of a structure for impounding water, the owner of the proposed structure shall submit, in duplicate, to the Conservation Commission complete drawings showing the location of the dam, the flow line of the impounded water, the boundary lines and the ownership of the property affected, the nature of the foundation bed, the character of the materials to be employed, the size and the location of the discharge and control gates, the general and special features of the dam, and such dimensions as are necessary for the calculation of the stresses and the erection of the structure.

Drawings shall be on sheets of uniform size 24 inches wide by 36 inches long. Each sheet shall have a white space 2¾ inches high by 5½ inches long below the title to receive the stamp of approval. On each sheet of every set of drawings there shall be clearly printed a conspicuous title in which shall appear the name of the county, the name of the city, village or town, and the name of the stream in which the dam is located, and the name of the owner thereof. The scale of the drawings shall be stated under the title. When the designs have been approved by the Commission, one set will be returned to the owner, with such approval endorsed thereon. Copies in duplicate of the specifications under which the dam is to be constructed shall accompany the plans.

Inspection.—The name of the inspector and a statement of his experience in such work must be sent to the Commission. There must also be sent a sample of at least one-half a cubic foot of sand and of cement, and twenty cubic inches of the stone for concrete or masonry to be used in the structure, and of the natural materials in the foundation bed. The foundation bed, after it has been cleared and prepared, must be inspected subject to approval by the Inspector of the Commission. The inspection of materials takes about ten days in the laboratory. On request tags will be sent for labeling the materials.

October 14th, 1913.

Mr. Carl P. Birkinbine,

Benson Mines Company,

Benson Mines, N. Y.

Dear Sir:-

We will leave Carthage on the Friday morning train for Oswegatchie.

Yours very truly,

CONSERVATION COMMISSION,

By

Inspector of Docks and Dams.

At Albany Tuesdays.

McK/E.

PHILADELPHIA OFFICE
1410 REAL ESTATE TRUST BLDG.

391 Mc Chr

Benson Mines Company

Robert K. Painter, Manager

Benson Mines, St. Lawrence County, N. Y.

October 13, 1913.

Mr. Alex. Rice McKim,
Inspector of Docks and Dams,
State Conservation Commission,
Albany, N.Y.

Dear Sir:-

Shortly after your departure last week we unwatered the cofferdam again and at once began excavation in it. We found a pocket worn in the rock, but have excavated this to its bottom, and have also found that on the down stream end it closed in, so that our foundations are not affected, except that we shall obtain an additional key against a natural shoulder by placing a little more concrete than we had previously anticipated. We shall therefore await you visit with eagerness, for conditions are such that even should we have rain to-morrow, it would only serve to further clean the surface of the rock.

We shall arrange to meet the 11:26 A.M. at Oswegatchie Wednesday, and if this is not agreeable to you will you kindly advise me when to expect you.

As yet we have not received the official permit from the Conservation Commission, and I am writing them, as naturally we are anxious to begin laying concrete, so as to advance the work before cold weather.

Very truly yours,

Engineer

391 Os chi

October 6th, 1913.

Mr. J. L. W. Birkinbine,
Benson Mines Company,
Benson Mines, N. Y.

Dear Sir:-

Yours of October 2nd received with prints for new dam and I have sent same in to the Commission.

I expect to be in Benson Mines on Wednesday, the 15th inst., and will inspect the foundation at that time.

Yours very truly,

Inspector of Docks and Dams.

McK/H.

PHILADELPHIA OFFICE
1410 REAL ESTATE TRUST BLDG.

391 Oswegatchie

Benson Mines Company

Robert K. Painter, Manager

Benson Mines, St. Lawrence, N. Y.

Setpber 4, 1813.

Mr. Alex. Rice McKim,
Inspector of Docks and Dams,
State Conservation Commission,
Albany, N.Y.

Dear Sir:

We have uncovered the base for the proposed dam on the Oswegatchie River and would appreciate your visiting it promptly so that we may advance constructiom befb re unfavorable weather sets in.

The side hills and a portion of the river which has been cofferdammed are now visible, and much of the rock in the ~~balan~~ balance of the channel can be observed,. The low water which occurs on Sundays would indicate more, but if you will give us the inppection before the 12th, as you originally stated, it would be a fovor to us. Will you kindly advise us regarding this, and also at what train you will arrive. The site is about 7 miles fpom here, and 4 miles from Oswegatchie, and I can have an automobile meet you at either place and accompany you.

We have sent the Commission blue prints of the dam accord ing to our understanding with you, Mr? Sherman and Mr? Cullings and if any matters whould come up on which you desire discussion please advise me by wire collect, so that I can at once proceed to Albany .

My brother has turned over to me your letter regarding joints each 50 feet of length, and thank you for your interest in the matter

Very truly yours

CPB/P

Carey Birkinbine

15 V

Benson Mines Company

Benson Mines, St. Lawrence County, N.Y.

November 29, 1913.

Mr. R. W. Sherman, Chief Engineer,
Conservation Commission, Albany, N.Y.

Dear Sir:

As I wired you yesterday, the change of the penstock location on the dam on the Oswegatchie River willnot be made, as I was successful in convincing my principals that this was not necessary. There is however and apology due you for not advising you sooner, due to the following reasons. I was telegraphed to meet the Vice President in New York Tuesday noon, and we discussed the matter, and he made a later appointment, and then another for Wednesday. In fact it was not until late Wednesday afternoon that final decision was reached, and I did not expect to find you at your office on Thanksgiving day. I trust you appreciate the situation as it occurred.

It is likely that I shall wish to see you in regard to another matter concerning this dam, that is to raise the height a foot or two, using the same base, which is now in, and making the upper steps heavier.

Will you please express to Mr. Van Kennan my thanks for his courtesy to me when I was at Albany, and I am also obliged to you for your promptness in writing about the blue prints sent you.

Very truly yours

Engineer

CFB/B

150

Oct. 14, 1913.

Mr. Carl Berkinbine, Engineer on Dam,
Benson Mines Company,
Benson Mines, N. Y.

Dear Sir:-

In reply to yours of the 13th inst., beg to advise that your plans and specifications for your dam at Brown's Falls were duly approved by a resolution adopted by the Conservation Commission today.

Yours truly,
Conservation Commission,
By R W Sherman
Chief Engineer.

RWS/F

PHILADELPHIA OFFICE
1410 REAL ESTATE TRUST BLDG.

RECEIVED
1913
DIVISION INLAND WATERS
Chief Engineer

CONSERVATION COMMISSION
COM'R MORSE
OCT 1 1913
RECEIVED

Benson Mines Company

O. J. Conley
~~Robert K. Painter~~, Manager

Benson Mines, St. Lawrence County, N. Y.

Oct. 13, 1913/

RECEIVED
OCT 14-1913
DIVISION INLAND WATERS
J. B. M.

Oct 14-1913
ANSWERED

State Conservation Commission,
Albany, N.Y.

Gentlemen:-

On the 3rd inst. we sent to your Commission designs of a dam to be built on the Oswegatchie River near Browns Falls. We have as yet not received the official permit, although I understand that the matter has the approval of your Chief Engineer and the Inspector of Docks and Dams, who has also visited and passed upon our foundations.

If there are any matters in question will you kindly advise me as promptly as possible, and I shall at once proceed to Albany to take them up with you. Naturally we are anxious to make as rapid progress as possible during the favorable weather.

Very truly yours

Carey Burkinbine
Engineer on Dam

CPB/B

PHILADELPHIA OFFICE
1410 REAL ESTATE TRUST BLDG.

Benson Mines Company

Owen J. Conley
~~Robert K. Painter~~, Manager

Benson Mines, St. Lawrence, N. Y.

October 2, 1913.

Mr. R. W. Sherman, Chief Engineer,
State Conservation Commission,
Albany, N?Y?

Dear Sir:

With this we are sending you two blue prints each of the abutment and rollway section of dam proposed for the Oswegatchie River. These are as per our understanding with you, Mr. McKim and Mr. Cullings, that this design would be acceptable.

Both of these cross sections are shown carried to greater depth than will actually be built, and the abutment section wil have a maximum height of only about 16 feet.

According to your calculations our original figures of 8 foot flood were excessive, and a 5 foot depth on crest will be sufficient.

We should appreciate your promptly advising us of the Commissions acceptance, so that we can proceed with the work of ~~bu~~ building forms and placing concrete as soon as the Inspector of Docks and Dams, Mr. McKim passes upon the foundations. We understand that he will visit the site on or before October 12th

Should you desire any further information, kindly address communications to Carl P. Birkinbine, Engineer on Dam.

Very truly yours

JLWB/P

J. L. W. Birkinbine
Assistant Manager

15v

BENSON MINES COMPANY
BENSON MINES, ST. LAWRENCE CO., N.Y.

PHILADELPHIA OFFICE
1410 REAL ESTATE TRUST BLDG.

ROBT. K. PAINTER, MANAGER
BENSON MINES, N. Y.

BENSON MINES, N. Y., September, 29, 13.

Mr. T. V. Radigan, Secy
Geo. E. VanKennen, Chairman,
Conservation Commission,
Albany, N.Y.

My dear Tom:-

This letter will introduce Mr. J.L.W. Birkinbine, our Assistant Manager, who is in Albany for the Company in the interests of the new dam. Any courtesies extended to him will be greatly appreciated,

Yours very truly,

James F. Lemon Jr.

J. L. W. Birkinbine
& his Father of Philadelphia, Pa
called to see you Tuesday
They are sons of Chairman
Birkinbine of the Pa Water Supply Commission

Letter - [illegible]
Inspects, Files

Sept. 29, 1913.

Mr. Robert K. Painter, Manager,
Benson Mines Company,
Benson Mines, N. Y.

Dear Sir:-

Yours of the 25th inst. over the signature of J. L. W. Birkinbine, Asst. Mgr., addressed to the Conservation Commission, attention of Alexander Rice McKim, Inspector of Docks & Dams, has been referred to the writer.

We have carefully examined your plans and specifications for your proposed concrete dam in the Oswegatchie River, and have noted and considered all that you say in your letter above mentioned.

Without considering uplift and ice pressure, your design is not safe against sliding. This objectionable feature might be overcome by sufficiently keying the dam into the underlying rock, ~~or~~ cutting the keys into the rock to a considerable depth and giving them a substantial cross section. Taking into consideration an uplift of a static head pressure at the heel, tapering to zero at the toe and using two-thirds thereof, and using an ice pressure near the flow line of 28,000 lbs. per lin. ft., the cross section of your dam is insufficient, and if such pressures occurred on the dam as you have designed it, it would immediately topple over.

Our Inspector of Docks & Dams, Mr. A. R. McKim, condemns your design, and one of our Assistant Engineers having carefully made calculations thereon reaches conclusions agreeing with Mr. McKim.

The writer as Chief Engineer will not recommend to the Commission for its approval plans and specifications for a dam on your proposed site unless the concrete is heavily keyed into the underlying rock to prevent sliding, and the cross section of the dam is of sufficient strength to insure its stability as a gravity dam against the static head, assuming a flood height 8 ft. above the lip of the weir plus uplift and ice pressure.

The writer has conferred with Commissioner Moore on the subject hereof this morning, following which he advises that you arrange for an interview at this office between your engineer and ours.

In the meantime, we caution you against doing anything whatever toward the construction of the dam until you first receive the formal approval by the Conservation Commission of your plans and specifications.

Yours truly,

Conservation Commission,

By R W Sherman

RWS/F

Chief Engineer.

BENSON MINES COMPANY

BENSON MINES, ST. LAWRENCE CO., N. Y.

ROBT. H. PAINTER, MANAGER
BENSON MINES, N. Y.

BENSON MINES, N. Y., Sept.25,1913.

CONCERNING DAM #391 OSWEGATCHIE WATERSHED.

Conservation commission.
State of New York.
Albany, N. Y.

ATTENTION OF MR. ALEX. RICE McKIM.
INSPECTOR OF DOCKS & DAMS.

Gentlemen:-

Your favors of the 22nd. and 23rd. inst. received together with an application blank which is filled out and returned to you together with drawings in duplicate. The various topics discussed in these letters will be replied to in the order they are written.

Drainage Area:-

The only map available for calculating the drainage area of the Oswegatchie River is the map of St. Lawrence County, published by Edgar G. Blankman of Canton. N.Y. dated 1897, scale one (1) mile to one (1) inch, which shows the drainage area above the proposed dam to be 127½ sq. miles, plus the drainage area of Cranberry Lake that is in Herkimer or Hamilton Counties. Of this drainage area only 31 sq. miles is below the State dam at Cranberry Lake which regulates the discharge of the Oswegatchie River and thus reduces the flood discharges. With this regulated discharge and the surface of the drainage area adapted for preventing rapid run off, I doubt if any abnormal freshet condition would discharge over 16,000 cu. ft. per sec., but as your commission is better versed upon this matter than I and have the records of the gauging station at Newton Falls (2½ miles above the proposed site) we will be grateful for any suggestions or instructions.

As the dam will, in all cases, rest upon solid rock, and is ample in design, the whole structure can be overflowed without injury, while in abnormal freshet conditions, the two waste gates, which are

CONSERVATION COMMISSION.

each 5'-6" x 5'-6" and are where center lines are 30'-9" below the top of the abutments of the dam can be opened. There will also be left in the dam an opening for a penstock, and in front of this will be two 6 ft. wide by 11ft. high control gates, with the center 19 ft. below the top of the abutment.

DAM DESIGN:

The design of the dam sent you was proposed under the direction of the consulting engineer, Mr. John Birkinbine of Philadelphia. Pa. Mr. Birkinbine has designed or passed upon the designs of a great number of dams of all sizes throughout this country, Canada and Mexico in his capacity as consulting engineer of many large corporations and as Chairman of the Water Supply Commission of the State of Pennsylvania since its inception but we will be glad to receive and I know Mr. Birkinbine will welcome any criticism or suggestion which you make upon the structure ,which will be carried out in the construction. As the work will be done by a contractor (Mr. L. B. Cleveland of Watertown,N.Y.) on force account, variations in the design or the construction can be made without conflicts with the contractor.

Regarding the upward thrust of water under the dam, we believe that by thoroughly roughening the surface of the rock and covering it with a rich mixture after all crevices have been thoroughly grouted, so that a complete bond will be secured between the concrete of the structure and the foundation rock, and designing the dam so that the resultants of the lines of forces falls well within the middle third so as to have none of the concrete under tension, that the upward thrust of the water may, with safety, be neglected, but as mentioned above, we will abide by your decision in this matter.

CONSERVATION COMMISSION

CONTRACTION JOINTS:

As you will notice in the specifications, contraction joints are required in the construction but they are called "key-ways". If my understanding is correct, these fulfill your requirement.

SPECIFICATIONS:

We are enclosing copy of the specifications which we hope will meet with your approval but we would welcome any criticism which you may make.

ICE PRESSURE:

On account of the dams at Newton Falls, 3 miles above the proposed dam and the long rapids at the head of the proposed dam, any ice not formed in the pool will be broken before reaching the pool, so the only ice which might cause a pressure will be formed in the pool. The fluctuations in the heigth of the water in the pool will cause the ice to break to a more or less extent. The upstream face of the rollway section of the dam is beveled so as to assist the ice to pass over the dam.

If we are to operate our concentrating mill this winter, it will be necessary to have this dam constructed, as it will assure us a constant supply and reduce the amount of anchor ice at our present plant. We have the contractor on the grounds preparing the foundations, placing equipment, etc;, so that the work can proceed as soon as we reweive the proper authorization from you. The foundations are ready for inspection and any action the commission takes to give us an early authorization will be greatly appreciated. As mentioned before, the work is being done on force account so changes can be made at any time without interference with the contractor.

The best time to examine the river bed is Sunday

afternoon until 10 o'clock Monday, when the river is very low, due to the closing down to the mills at Newton Falls over Sunday.

To-day we are sending you the following:-

2 Blue Prints #5000 Contour map of East Branch of the Oswegatchie River.

2 " " #5001 Topographic map at proposed dam site.

2 " " #5002 Cross section of Oswegatchie River at proposed dam site

2 " " #5005 Profile of Proposed Dam (Abutment)

2 " " #5006 Profile of proposed Rollway

2 Copies of Specifications.

Very truly yours,

BENSON MINES COMPANY

J L W Birkinbine Ass't. Manager

BENSON MINES COMPANY

BENSON MINES, ST. LAWRENCE CO., N. Y.

PHILADELPHIA OFFICE
1010 REAL ESTATE TRUST BLDG.

ROBT. H. PAINTER, MANAGER
BENSON MINES, N. Y.

BENSON MINES, N. Y., Sept, 24, 13.

Mr. Alex. Rice McKim,
Inspector of Docks & Dams,
Albany, N.Y.

Dear sir:-

We have your two letters of September, 22nd., and 23rd., contents of which have been carefully gone over by Mr. Birkinbine, and he will reply to them in detail later on.

We are now filling out the blank forwarded us for the construction of the dam, which will be signed by Mr. O. J. Conley, General Manager, and the chief representative of the Benson Mines Company on the ground.

By express today we are forwarding you the required sample of sand and gravel that is to be used in the construction of the dam as specified in the instructions.

Thanking you for your courteous and kind attention in this matter we are,

Yours very truly,

BENSON MINES COMPANY.

per [illegible]

P.S. Necessary drawings will be mailed you in correct form as soon as completed.

September 23, 1913.

Mr. J. L. W. Birkinbine,
Benson Mines Co.,
Benson Mines, N. Y.

Dear Sir:-

In my letter to you yesterday relative to dam #391 Oswego Watershed, I neglected to ask you about the ice forming on the river, whether it is liable to cause an ice pressure upon the dam. If so this should be taken into consideration in the design of the dam. When the drawings are sent in, will you please inform me concerning this subject?

Very truly yours,
Conservation Commission,
By
Inspector of Docks and Dams.
At Albany Tuesdays.

McK/C.

September 22, 1913.

Concerning Dam #391 Oswegatchie Watershed.

Mr. J. L. W. Birkinbine,

Benson Mines Co.,

Benson Mines, N. Y.

Dear Sir:-

I sent you to-day, by your representative, an application blank which is to be filled out and returned to this Commission for its approval, together with drawings, in duplicate, as per instructions on the last page thereof.

The drainage area I calculate to be about 200 square miles, the probable high flow about 10,000 feet second and the possible high flow at least 20,000 feet second. In case of such a possible flow, how are you to take care of the same safely? What will the penstocks accommodate and can the whole dam be overflowed without doing any damage, that is, is there rock ledge upon the whole bottom and sides? Otherwise the dam must be raised to the ends, so as to protect the banks.

I find the section of the dam, as set in, does not take into account the uplift of the action of the water underneath, and suggest that the upstream face be made vertical instead of stepped off, which would throw the weight forward and help con-

siderably in this, and the dam be made sufficiently thick in order to provide for the uplift action under the dam.

Contraction joints should be provided at least about every 50 feet, as, for instance, by making 4-inch off-sets and returns, alternating every 2 feet for the entire width of the dam and made parallel to the upstream face.

I do not know the nature or character of the rock foundation bed, but, if there is to be a cut-off wall, the place for same is near the upstream face and the depth depends upon the kind of rock and its liability to fissures. If there is a possibility of very deep fissures, it may be wise to have foundations drilled and tested under pressure.

The law also requires that specifications be submitted.

Very truly yours,

Conservation Commission,

By

Inspector of Docks and Dams.

At Albany Tuesdays.

McK/C.

AD-A077 483 NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/13
NATIONAL DAM SAFETY PROGRAM. BROWNS FALLS DAM (INVENTORY NUMBER--ETC(U)
SEP 79 J B STETSON DACW51-79-C-0001

UNCLASSIFIED NL

3 OF 3
ADA
077483

END
DATE
FILMED
12-79
DDC

END
DATE
FILMED
12-79
DDC

STATE OF NEW YORK

CONSERVATION COMMISSION

ALBANY

July 7th, 1913.

Hon. John D. Moore, Commissioner,

Conservation Commission.

Dear Sir:-

Yours of the 2nd inst. has been received, which reads as follows:

"On June 10th I sent you a clipping from the Lowville Journal and Republican of May 1st. This clipping stated that the Benson Mines Ore Company was about to build a dam 100 feet high at Brown Falls near the village of Oswegatchie. What are the facts in regard to this? Have we any records?"

I have taken this subject up verbally with Inspector McKim and learn that he has had some correspondence with the Benson Mines Ore Company on the subject which Mr. McKim is still following up. I am satisfied that it will not escape his careful attention.

From my personal inspection of the Oswegatchie River and valley ~~and~~ from the St. Lawrence River ~~through~~ to Cranberry Lake about a year ago, ~~I am~~ and in recalling the physical conditions at and near Brown Falls. I am of the opinion that it is not the intention of the Benson Mines Ore Company or any other party to build a dam 100 feet high as it seems perfectly apparent that the most feasible and

economical development would be by a long penstock covering the head in preference to a high dam.

Respectfully yours,

R W Sherman

RWS/H. Chief Engineer.

FILE

July 7-1913

July 2, 1913.

Chief Engineer Sherman.

Dear Chief:

On June 10th I sent you a clipping from the Lowville Journal and Republican of May 1st. This clipping stated that the Benson Mines Ore Company was about to build a dam 100 feet high at Brown Falls near the village of Oswegatchie. What are the facts in regard to this? Have we any records?

John D Lawson

Commissioner.

JDM/M

FORM IW 57

IN REPLYING PLEASE REFER TO FILE NUMBER

STATE OF NEW YORK

CONSERVATION COMMISSION

ALBANY

FILE

June 12, 1913.

Hon. John D. Moore, Commissioner,
Conservation Commission,
Albany, N. Y.

RECEIVED
JUN 13 1913
DIVISION INLAND WATERS
J. D. M.

Dear Sir:-

Your memorandum of the 10th inst. with clipping on the subject of proposed dam to be constructed by the Benson Mines Ore Company at Brown's Falls on the Oswegatchie River, has been received.

I have conferred with Inspector McKim on this subject, and learn that he has it in hand and has written the Ore Company for information, plans, etc., but has not so far received a reply. The matter will be followed up and have proper attention.

Yours truly,

R W Sherman

RWS/F

Chief Engineer.

RECEIVED
JUN 1 1913
DIVISION INLAND WATERS
Chief Engineer

ANSWERED
June 11 1913

FILE

MEMORANDUM.

June 10, 1913.

Chief Engineer Sherman.

Dear Chief:

Attached herewith is a clipping from the Journal and Republican of May 1st, which states that the Benson Mines Ore Company is about to build a dam 100 feet high at Brown Falls near the village of Oswegatchie. Have we any information on this or have we made any inquiry in reference to it?

Commissioner.

JDM/M

To Miss M

~~May 2~~ June 5, 1913

H.A.M.

Journal and Republican
Lowville
Oswegatchie

May 1 1913

Inspector McKim

DA[illegible] FEET HIGH.

Ben[illegible] [illegible] Ore Company Announces Preliminary Plans.

Another project for the development of electric power will soon be established on the Oswegatchie river. The Benson Mines Ore Company will shortly build a [illegible] just above the site of its present plant at Brown falls three miles from the village of Oswegatchie. The new dam will be 100 feet high and constructed of concrete and steel. It will be one of the highest dams in northern New York.

A year ago the company build a power plant, but it is situated just below a series of rapids in which drift ice forms. Ice gathered in the flume and penstock, compelling the company to close down. The new dam will be built in still water so that no anchor ice will be formed to interfere with the operations.

Brown falls for nearly a century has been a power site of great value. The forests rising from the hills close at hand enclosed a series of cascades, which presented a scene of much beauty.

BENSON MINES COMPANY

BENSON MINES, ST. LAWRENCE CO., N. Y.

df.

Referred to Inspector Meeting.
AHS.

BENSON MINES, N. Y., March 25, 1913.

The Conservation Commission,
Albany, N.Y.

391 Os. chi.

Gentlemen:-

Replying to your inquiry of the 25th., inst., beg to advise that we have not contemplated, nor do we expect to build a dam at Benson Mines this year. Trusting this information will serve your purpose, we remain,

Very truly yours,

O. J. Bailey

Dict-OJC. Manager.

March 24, 1913.

Benson Mines Company,

Benson Mines, St. Lawrence Co., N. Y.

Gentlemen:-

It is reported that you are about to construct a dam at Benson mines, but no plans have been filed with this Commission for approval. I enclose an application to be filled out and submitted to the Commission.

Very truly yours,

Conservation Commission,

By

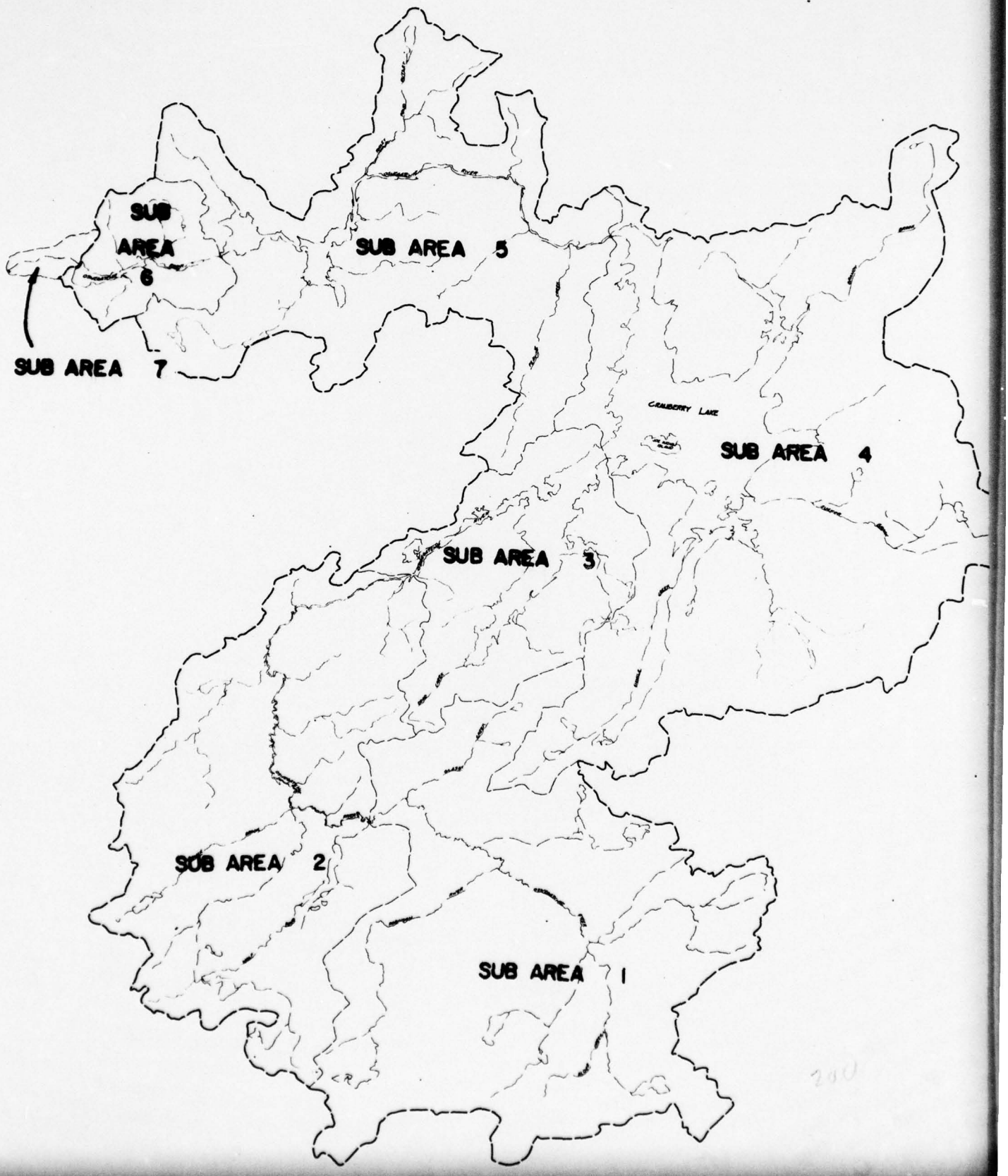
Inspector of Docks and Dams.

McK/C.

Encl.

APPENDIX C

HYDROLOGIC AND HYDRAULIC COMPUTATIONS


SUB AREA 6
SUB AREA 5
SUB AREA 7
CRANBERRY LAKE
SUB AREA 4
SUB AREA 3
SUB AREA 2
SUB AREA 1

STETSON • DALE BANKERS TRUST BUILDING UTICA • NEW YORK • 13501 TEL 315-797-5800 **DESIGN BRIEF**

PROJECT NAME NEW YORK STATE DAM INSPECTION DATE 8·28·79

SUBJECT BROWN'S FALLS DAM PROJECT NO. 2305

SUB AREAS - AREA DRAWN BY JPG

		Acres	Sq Mi
Sub Area	1	26752.4	41.7
" "	2	21074.4	32.9
" "	3	9356.3	14.6
" "	4	40768.0	63.7
" "	5	16576.0	25.9
" "	6	3237.8	5.1
" "	7	458.2	.72

TOTAL 117700± ACRES 183.9 Sq M

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TEL 315-797-5800

DESIGN BRIEF

PROJECT NAME NEW YORK STATE DAM INSPECTION DATE 8.29.79

SUBJECT BROWN'S FALLS DAM PROJECT NO. 2305

ESTIMATE OF CLARK'S PARAMETERS DRAWN BY JPG

$T_c = 11.9 (L^3/H)^{.3}$

	L (MI)	H(FT)	T_c
SUB AREA 1	10.83	705	14.20
" " 2	16.55	755	20.37
" " 3	6.63	555	9.81
" " 4	12.80	1035	14.71
" " 5	12.69	504	18.11
" " 6	3.56	431	6.05
" " 7	1.78	492	3.11

$L = \frac{\ell^{.8} (S+1)^{.7}}{1900\, Y^{.5}}$ $\quad T_c = L/.6$

	ℓ(FT)	S	Y(%)	L	T_c
SUB AREA 1	57200	4.28	7	4.08	6.79
" " 2	87400	4.28	6	6.18	10.31
" " 3	35000	3.51	5	2.92	4.86
" " 4	67600	3.51	7	4.17	6.96
" " 5	67000	4.28	7	4.62	7.71
" " 6	18800	4.28	7	1.67	2.79
" " 7	9400	4.28	7	.96	1.60

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DESIGN BRIEF

PROJECT NAME NEW YORK STATE DAM INSPECTION DATE 8.29.79

SUBJECT BROWN'S FALLS DAM PROJECT NO. 2305

ESTIMATE OF SNYDER'S PARAMETER DRAWN BY JPG

$t_p = C_t (L \times L_{CA})^{.385}$

		C_t	$L_{(MI)}$	$L_{CA(MI)}$	t_p
SUB AREA	1	2.5	10.83	7.50	13.59
" "	2	2.5	16.55	7.75	16.20
" "	3	3.0	6.63	3.50	10.07
" "	4	3.0	12.80	6.75	16.70
" "	5	2.5	12.69	6.75	13.87
" "	6	2.5	3.56	1.75	5.05
" "	7	2.5	1.78	.75	2.79

$t_r = t_p / 5.5$

		t_p	t_r
SUB AREA	1	13.59	2.47
" "	2	16.20	2.95
" "	3	10.07	1.83
" "	4	16.70	3.04
" "	5	13.87	2.52
" "	6	5.05	.92
" "	7	2.79	.57

$t_{pr} = t_p + .25 (t_R - t_r)$

		t_p	t_R	t_r	t_{pr}
SUB AREA	1	13.59	1.0	2.47	13.22
" "	2	16.20		2.95	15.71
" "	3	10.07		1.83	9.86
" "	4	16.70		3.04	16.19
" "	5	13.87		2.52	13.49
" "	6	5.05		.92	5.07
" "	7	2.79	1.0	.57	2.90

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TEL 315-797-5800

DESIGN BRIEF

PROJECT NAME New York State Dam Inspection DATE 8.29.79

SUBJECT Brown's Falls Dam PROJECT NO. 2305

Depth - Duration Relationship DRAWN BY JPG

PMF Index - 18.5"; 24 Hr; 200 Sq Mi

Duration	Depth	% of Index
6 Hr	14.1	76
12 Hr	16.7	90
24 Hr	18.9	102
48 Hr	19.6	106

```
(0077)  P       0     18.5      76      90     102     106
(0078)  T       0        0       0       0       0       0       1     0.1
(0079)  N   13.87      .77
(0080)  X      51       51
(0081)  K       2       50       0       0       0       0       1
(0082)  K1        COMBINE 2 HYDROGRAPHS AT 5C
(0083)  K       1      500       0       0       0       0       1
(0084)  K1        ROUTE OVER NEWTON FALLS DAM
(0085)  Y       0        0       0       1       1
(0086)  Y1      1        0       0       0       0       0      -1
(0087)  Y4   1421     1422    1423    1424    1425    1426    1427    1428    1429    1430
(0088)  Y5      0      167     471     865    1331    3330    6603   10720   15525   20927
(0089)  K       1       60       0       0       0       0       1
(0090)  K1        CHANNEL ROUTE THRU SUB AREA-6
(0091)  Y       0        0       0       1       1
(0092)  Y1      1        0       0       0       0       0      -1
(0093)  Y6    .08      .04     .08    1324    1400   14200    .002
(0094)  Y7    100     1400     600    1360     700    1344    1000    1324    1100    1324
(0095)  Y7   1500     1344    1800    1360    2700    1400
(0096)  K       0        6       0       0       0       0       1
(0097)  K1        SUB AREA-6 RUNOFF
(0098)  M       1        1     5.1       0   183.9       0       0       0       1
(0099)  P               18.5      76      90     102     106
(0100)  T       0        0       0       0       0       0       1     0.1
(0101)  N    5.05      .77
(0102)  X      10       10       1
(0103)  K       2       60       0       0       0       0       1
(0104)  K1        COMBINE 2 HYDROGRAPHS AT 6C
(0105)  K       1       60       0       0       0       0       1
(0106)  K1        ROUTE OVER BROWNS FALLS DAM
(0107)  Y       0        0       0       1       1
(0108)  Y1      1        0       0       0       0       0      -1      -1
(0109)  Y4   1347     1348    1349    1350    1351    1352    1353    1355    1357    1359
(0110)  Y5      0      630    1990    3900    6250    8910   11710   18030   25200   33120
(0111)  $S      0      143     288     437     588     744     903    1064    1233    1405
(0112)  $S   1560     1761    1946    2137
(0113)  $E   1347     1348    1349    1350    1351    1352    1353    1354    1355    1356
(0114)  $E   1357     1358    1359    1360
```

```
(0115)  $$  1347
(0116)  $D  1352    2.64     1.5    680.0
(0117)  K      1      70       0       0       0       0       1
(0118)  K1      CHANNEL ROUTE THRU SUB AREA-7
(0119)  Y       0       0       0       1       1
(0120)  Y1      1       0       0       0       0       0      -1
(0121)  Y6   .08      .04     .08      1119      1200    7000    .039
(0122)  Y7   100     1200     400     1160     550     1120     551     1119     559     1119
(0123)  Y7   600     1120     700     1140     900     1200
(0124)  K       0       7       0       0       0       0       1
(0125)  K1      SUB AREA-7 RUNOFF
(0126)  M       1       1     .72       0   183.9       0       0       0       1
(0127)  P       0    18.5      76      90     102     106
(0128)  T       0       0       0       0       0       0       1     0.1
(0129)  W   2.79     .77
(0130)  X       2       2       1
(0131)  K       2      70       0       0       0       0       1
(0132)  K1      COMBINE 2 HYDROGRAPHS AT 70
(0133)  K      99
(0134)  A
(0135)  A
(0136)  A
(0137)  A
(0138)  A
```

```
PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS
        RUNOFF HYDROGRAPH AT            1
        ROUTE HYDROGRAPH TO            20
        RUNOFF HYDROGRAPH AT            2
        COMBINE  2 HYDROGRAPHS AT      20
        ROUTE HYDROGRAPH TO            30
        RUNOFF HYDROGRAPH AT            3
        COMBINE  2 HYDROGRAPHS AT      30
        ROUTE HYDROGRAPH TO            40
        RUNOFF HYDROGRAPH AT            4
        ROUTE HYDROGRAPH TO           400
        ROUTE HYDROGRAPH TO            50
        RUNOFF HYDROGRAPH AT            5
        COMBINE  2 HYDROGRAPHS AT      50
        ROUTE HYDROGRAPH TO           500
        ROUTE HYDROGRAPH TO            60
        RUNOFF HYDROGRAPH AT            6
        COMBINE  2 HYDROGRAPHS AT      60
        ROUTE HYDROGRAPH TO            60
        ROUTE HYDROGRAPH TO            70
        RUNOFF HYDROGRAPH AT            7
        COMBINE  2 HYDROGRAPHS AT      70
        END OF NETWORK
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE?THU, SEP 13 1979
     TIME?14:03:22

                    BROWNS FALLS DAM
                    HEC-1DB
                    PMF-OVERTOPPING ANALSIS (SNYDERS)

                                JOB SPECIFICATION
          NQ      NHR     NMIN     IDAY     IHR     IMIN    METRC     IPLT     IPRT   NSTAN
          90        1        0        0       0        0        0        0        4       0
                                   JOPER      NWT   LROPT   TRACE
                                       5        0       0       0

                              MULTI-PLAN ANALYSES TO BE PERFORMED
                                   NPLAN= 1 NRTIO= 6 LRTIO= 1
                RTIOS=   0.20   0.40   0.50   0.60   0.80   1.00

**********      **********      **********      **********      **********

                              SUB-AREA RUNOFF COMPUTATION

                SUB AREA-1 RUNOFF
                         ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                             1       0       0       0       0       0       1       0       0

                                    HYDROGRAPH DATA
          IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIC   ISNOW   ISAME   LOCAL
              1       1   41.70    0.00  183.90    0.00   0.000       0       1       0

                                    PRECIP DATA
                    SPFE     PMS      R6     R12     R24     R48     R72     R96
                    0.00   18.50   76.00   90.00  102.00  106.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS 0.881

                                    LOSS DATA
          LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
              0    0.00    0.00    1.00    0.00    0.00    1.00    1.00    0.10    0.00    0.00

                                UNIT HYDROGRAPH DATA
                            TP= 13.59    CP=0.77    NTA=  0

                                RECESSION DATA
                          STRTQ=   84.00    QRCSN=   84.00    RTIOR= 1.00
```

UNIT HYDROGRAPH 49 END-OF-PERIOD ORDINATES, LAG= 13.50 HOURS, CP= 0.76 VOL= 1.00

35.	129.	259.	407.	564.	726.	891.	1055.	1214.	1351.
1453.	1521.	1557.	1564.	1540.	1483.	1377.	1227.	1073.	938.
820.	717.	627.	548.	480.	419.	367.	321.	280.	245.
214.	187.	164.	143.	125.	110.	96.	84.	73.	64.
56.	49.	43.	37.	33.	29.	25.	22.	19.	

C

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	17.27	14.14	3.13	385828.
										(439.)	(359.)	(80.)	(10925.42)

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

CHANNEL ROUTE THRU SUB AREA-2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
20	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
0.0800	0.0400	0.0800	1569.0	1600.0	45400.	0.00200

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

100.00 1600.00 1100.00 1580.00 1220.00 1571.00 1230.00 1569.00 1300.00 1569.00
1310.00 1571.00 1400.00 1580.00 1700.00 1600.00

STORAGE	0.00	132.89	304.59	540.07	840.26	1205.18	1634.82	2132.99	2779.57
	4613.61	5861.05	7168.79	8716.82	10445.14	12353.76	14442.67	16711.86	19161.35
OUTFLOW	0.00	274.81	965.30	2055.61	3557.36	5496.14	7899.20	10790.57	13916.52
	22997.64	29014.43	36141.40	44471.38	54094.23	65096.77	77563.09	91574.81	107211.36
STAGE	1569.00	1570.63	1572.26	1573.89	1575.53	1577.16	1578.79	1580.42	1582.05
	1585.31	1586.94	1588.58	1590.21	1591.84	1593.47	1595.10	1596.73	1598.36

```
      FLOW        0.00      274.81      965.30     2055.61     3557.36     5496.14     7899.20    10690.57    13916.52
                22997.64    29014.43    36141.40    44471.38    54094.23    65096.77    77563.09    91574.81   107211.36

MAXIMUM STAGE IS     1575.8

MAXIMUM STAGE IS     1578.8

MAXIMUM STAGE IS     1579.9

MAXIMUM STAGE IS     1580.9

MAXIMUM STAGE IS     1582.7

MAXIMUM STAGE IS     1584.2

**********          **********          **********          **********          **********

                              SUB-AREA RUNOFF COMPUTATION

                    SUB AREA-2
                          ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                              2       0       0       0       0       0       1       0       0

                                        HYDROGRAPH DATA
                    IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                        1       1   32.90    0.00  183.90    0.00   0.000       0       1       0

                                        PRECIP DATA
                              SPFE     PMS      R6     R12     R24     R48     R72     R96
                              0.00   18.50   76.00   90.00  102.00  106.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS 0.881

                                        LOSS DATA
                    LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
                        0    0.00    0.00    1.00    0.00    0.00    1.00    1.00    0.10    0.00    0.00

                                  UNIT HYDROGRAPH DATA
                              TP= 16.20    CP=0.77    NTA=  0

                                    RECESSION DATA
                              STRTQ=   66.00    QRCSN=   66.00    RTIOR= 1.00

      UNIT HYDROGRAPH 60 END-OF-PERIOD ORDINATES, LAG=  16.17 HOURS, CP= 0.76  VOL= 1.00
        18.      67.     135.     213.     298.     387.     479.     571.     664.     756.
       841.     911.     965.    1003.    1026.    1034.    1029.    1008.     970.     906.
       820.     735.     659.     591.     530.     475.     426.     382.     343.     307.
       276.     247.     222.     199.     178.     160.     143.     128.     115.     103.
        93.      83.      74.      67.      60.      54.      48.      43.      39.      35.
        31.      28.      25.      22.      20.      18.      16.      15.      13.      12.
```

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	17.27	14.14	3.13	302270.
										(439.)(359.)(80.)(8559.32)			

********** ********** ********** ********** **********

COMBINE HYDROGRAPHS

COMBINE 2 HYDROGRAPHS AT 20

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
20	2	0	0	0	0	1	0	0

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

CHANNEL ROUTE THRU SUB AREA-3

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
30	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
0.0800	0.0400	0.0800	1470.0	1520.0	23600.	0.00001

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

100.00 1520.00 200.00 1500.00 400.00 1485.00 500.00 1470.00 1600.00 1470.00
1750.00 1485.00 2000.00 1500.00 2100.00 1520.00

STORAGE	0.00	1559.44	3261.40	4985.88	6772.88	8622.40	10536.69	12551.24	14678.34
	19270.14	21734.84	24298.63	26905.96	29550.82	32233.18	34953.05	37710.42	40505.32
OUTFLOW	0.00	654.18	2091.50	4141.12	6739.70	9852.54	13540.41	17525.17	22823.81
	34147.16	40566.88	47523.94	54993.27	62938.22	71348.50	80215.61	89532.16	99292.02
STAGE	1470.00	1472.63	1475.26	1477.89	1480.53	1483.16	1485.79	1488.42	1491.05
	1496.31	1498.94	1501.58	1504.21	1506.84	1509.47	1512.10	1514.73	1517.36
FLOW	0.00	654.18	2091.50	4141.12	6739.70	9852.54	13540.41	17525.17	22823.81

34147.16 40566.88 47523.94 54493.27 62938.22 71348.50 80215.61 89532.16 99292.02

MAXIMUM STAGE IS 1478.0

MAXIMUM STAGE IS 1483.1

MAXIMUM STAGE IS 1485.2

MAXIMUM STAGE IS 1487.1

MAXIMUM STAGE IS 1490.5

MAXIMUM STAGE IS 1493.5

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SUB-AREA RUNOFF COMPUTATION

SUB AREA-3 RUNOFF

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	14.60	0.00	183.90	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	18.50	76.00	90.00	102.00	106.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS 0.881

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.10	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 10.07 CP=0.77 NTA= 0

RECESSION DATA

STRTQ= 30.00 QRCSN= 30.00 RTIOR= 1.00

UNIT HYDROGRAPH 38 END-OF-PERIOD ORDINATES, LAG= 10.02 HOURS, CP= 0.76 VOL= 1.00

25.	92.	182.	282.	386.	492.	591.	667.	713.	732.
725.	687.	609.	514.	432.	364.	306.	257.	216.	182.
153.	129.	108.	91.	77.	64.	54.	46.	38.	32.
27.	23.	19.	16.	14.	11.	10.	8.		

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	17.27	14.14	3.13	135216.

(439.)(359.)(80.)(3828.89)

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COMBINE HYDROGRAPHS

COMBINE 2 HYDROGRAPHS AT 30

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
30	2	0	0	0	0	1	0	0

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HYDROGRAPH ROUTING

CHANNEL ROUTE THRU SUB AREA-4

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
40	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
0.0800	0.0400	0.0800	1460.0	1520.0	2460.	0.00001

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
100.00 1500.00 400.00 1500.00 700.00 1485.00 750.00 1460.00 2200.00 1460.00
2350.00 1485.00 2400.00 1500.00 2700.00 1520.00

STORAGE	0.00	2608.28	5261.61	7960.00	10703.42	13491.90	16325.43	19204.01	22127.93
	28297.32	31579.11	34992.28	38712.20	42884.07	47140.41	51481.24	55906.50	60416.24
OUTFLOW	0.00	1163.75	3704.20	7300.17	11823.62	17198.25	23372.23	30307.68	38008.59
	56374.23	66694.02	77768.63	89460.95	102298.61	115999.42	130536.31	145892.09	162054.41
STAGE	1460.00	1463.16	1466.32	1469.47	1472.63	1475.79	1478.95	1482.10	1485.26
	1491.58	1494.73	1497.89	1501.05	1504.21	1507.37	1510.52	1513.68	1516.84
FLOW	0.00	1163.75	3704.20	7300.17	11823.62	17198.25	23372.23	30307.68	38008.59
	56374.23	66694.02	77768.63	89460.95	102298.61	115999.42	130536.31	145892.09	162054.41

MAXIMUM STAGE IS 1469.8

MAXIMUM STAGE IS 1470.1

MAXIMUM STAGE IS 1472.0

MAXIMUM STAGE IS 1473.8

MAXIMUM STAGE IS 1477.2

MAXIMUM STAGE IS 1480.3

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SUB-AREA RUNOFF COMPUTATION

SUB AREA-4 RUNOFF

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	63.70	0.00	183.90	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	Ro	R12	R24	R48	R72	R96
0.00	18.50	76.00	90.00	102.00	106.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS 0.881

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.10	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 16.70 CP=0.77 NTA= 0

RECESSION DATA

STRTQ= 128.00 QRCSN= 128.00 RTIOR= 1.00

UNIT HYDROGRAPH 61 END-OF-PERIOD ORDINATES, LAG= 16.58 HOURS, CP= 0.76 VOL= 1.00

32.	121.	245.	387.	542.	703.	869.	1037.	1205.	1373.
1535.	1675.	1784.	1865.	1919.	1948.	1951.	1929.	1880.	1799.
1667.	1504.	1349.	1210.	1086.	974.	874.	784.	703.	631.
566.	508.	456.	409.	367.	329.	295.	265.	238.	213.
191.	172.	154.	138.	124.	111.	100.	89.	80.	72.
65.	58.	52.	47.	42.	38.	34.	30.	27.	24.
22.									

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

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                                                    SUM  17.27  14.14   3.13   584735.
                                                         ( 439.)( 359.)(  80.)(16557.84)

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                                        HYDROGRAPH ROUTING

                    ROUTE OVER CRANBERRY LAKE DAM
                              ISTAQ   ICOMP   IECON   ITAPE   JPLT   JPRT   INAME  ISTAGE  IAUTO
                                400       1       0       0      0      0       1       0      0
                                                ROUTING DATA
                             QLOSS   CLOSS     AVG   IRES   ISAME   IOPT   IPMP          LSTR
                               0.0   0.000    0.00      1       1      0      0             0

                              NSTPS   NSTDL     LAG   AMSKK        X    TSK   STORA  ISPRAT
                                  1       0       0   0.000    0.000  0.000    -1.       0

     STAGE      1490.00     1491.00     1492.00     1493.00     1494.00     1495.00     1496.00     1497.00     1498.00

      FLOW         0.00      352.00      995.00     1829.00     2816.00     3936.00     5173.00     6519.00     7965.00

 MAXIMUM STAGE IS     1491.0

 MAXIMUM STAGE IS     1491.5

 MAXIMUM STAGE IS     1491.8

 MAXIMUM STAGE IS     1492.0

 MAXIMUM STAGE IS     1492.7

 MAXIMUM STAGE IS     1493.4

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                                        HYDROGRAPH ROUTING

                    CHANNEL ROUTE THRU SLB AREA-5
                              ISTAQ   ICOMP   IECON   ITAPE   JPLT   JPRT   INAME  ISTAGE  IAUTO
                                50       1       0       0      0      0       1       0      0
                                                ROUTING DATA
                             QLOSS   CLOSS     AVG   IRES   ISAME   IOPT   IPMP          LSTR
                               0.0   0.000    0.00      1       1      0      0             0

                              NSTPS   NSTDL     LAG   AMSKK        X    TSK   STORA  ISPRAT
                                  1       0       0   0.000    0.000  0.000    -1.       0

 NORMAL DEPTH CHANNEL ROUTING
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QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
0.0800	0.0400	0.0800	1430.0	146.0	45600.	0.00040

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

100.00 1460.00 400.00 1440.00 590.00 1435.00 600.00 1430.00 740.00 1430.00
750.00 1435.00 2000.00 1440.00 2300.00 1460.00

STORAGE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OUTFLOW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STAGE	1430.00	1362.42	1294.84	1227.26	1159.68	1092.10	1024.53	956.95	889.37
	754.21	686.63	619.05	551.47	483.89	416.31	348.74	281.16	213.58
FLOW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MAXIMUM STAGE IS 1430.0

MAXIMUM STAGE IS 1430.0

MAXIMUM STAGE IS 1430.0

MAXIMUM STAGE IS 1430.0

MAXIMUM STAGE IS 1430.0

MAXIMUM STAGE IS 1430.0

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SUB-AREA RUNOFF COMPUTATION

SUB AREA-5 RUNOFF

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	25.90	0.00	183.90	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	18.50	76.00	90.00	102.00	106.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS 0.881

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.10	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 13.87 CP=0.77 NTA= 0

RECESSION DATA

STRTQ= 51.00 QRCSN= 51.00 RTIOR= 1.00

UNIT HYDROGRAPH 51 END-OF-PERIOD ORDINATES, LAG= 13.85 HOURS, CP= 0.77 VOL= 1.00

20.	76.	153.	240.	333.	430.	527.	625.	722.	806.
871.	916.	942.	950.	941.	913.	862.	779.	684.	600.
527.	463.	406.	357.	313.	275.	241.	212.	186.	163.
143.	126.	110.	97.	85.	75.	66.	58.	51.	44.
39.	34.	30.	26.	23.	20.	18.	16.	14.	12.
11.									

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	17.27	14.14	3.13	239561.
										(439.)	(359.)	(80.)	(6783.61)

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COMBINE HYDROGRAPHS

COMBINE 2 HYDROGRAPHS AT 50

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
50	2	0	0	0	0	1	0	0

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HYDROGRAPH ROUTING

ROUTE OVER NEWTON FALLS DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
500	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

STAGE	1421.00	1422.00	1423.00	1424.00	1425.00	1426.00	1427.00	1428.00	1429.00

FLOW	0.00	167.00	471.00	865.00	1331.00	3330.00	6603.00	10720.00	15525.00

MAXIMUM STAGE IS 1425.6

MAXIMUM STAGE IS 1426.6

MAXIMUM STAGE IS 1427.0

MAXIMUM STAGE IS 1427.3

MAXIMUM STAGE IS 1427.9

MAXIMUM STAGE IS 1428.5

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HYDROGRAPH ROUTING

CHANNEL ROUTE THRU SUB AREA=6

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
60	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

GN(1)	GN(2)	GN(3)	ELNVT	ELMAX	RLNTH	SEL
0.0800	0.0400	0.0800	1324.0	1400.0	14200.	0.00200

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

100.00 1400.00 600.00 1360.00 700.00 1344.00 1000.00 1324.00 1100.00 1324.00
1500.00 1344.00 1800.00 1360.00 2700.00 1400.00

STORAGE	0.00	221.67	625.90	1212.67	1982.00	2933.88	4042.24	5280.99	6650.14
	9805.69	11644.26	13665.38	15869.05	18255.28	20824.06	23575.39	26509.27	29625.71
OUTFLOW	0.00	2266.73	9410.19	22987.27	44467.41	75202.09	125124.31	185762.94	257099.13
	431626.38	535650.63	651585.50	779797.25	920656.38	1074533.00	1241794.50	1422805.75	1617927.25
STAGE	1324.00	1328.00	1332.00	1336.00	1340.00	1344.00	1348.00	1352.00	1356.00
	1364.00	1368.00	1372.00	1376.00	1380.00	1384.00	1388.00	1392.00	1396.00
FLOW	0.00	2266.73	9410.19	22987.27	44467.41	75202.09	125124.31	185762.94	257099.13

451626.38 555650.63 651563.50 779797.25 920656.38 1074533.00 1241794.50 1422805.75 1617927.25

MAXIMUM STAGE IS 1328.2

MAXIMUM STAGE IS 1329.7

MAXIMUM STAGE IS 1330.4

MAXIMUM STAGE IS 1331.1

MAXIMUM STAGE IS 1332.3

MAXIMUM STAGE IS 1333.1

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SUB-AREA RUNOFF COMPUTATION

SUB AREA-6 RUNOFF

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	5.10	0.00	183.90	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	18.50	76.00	90.00	102.00	106.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS 0.881

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.10	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 5.05 CP=0.77 NTA= 0

RECESSION DATA

STRTQ= 10.00 QRCSN= 10.00 RTIOR= 1.00

UNIT HYDROGRAPH 18 END-OF-PERIOD ORDINATES, LAG= 5.02 HOURS, CP= 0.76 VOL= 1.00

44.	155.	291.	417.	493.	499.	427.	310.	210.	143.
97.	66.	45.	30.	21.	14.	9.	6.		

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	17.27	14.14	3.13	47209.
										(439.)	(359.)	(80.)	(1336.81)

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COMBINE HYDROGRAPHS

COMBINE 2 HYDROGRAPHS AT 60

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
60	2	0	0	0	0	1	0	0

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HYDROGRAPH ROUTING

ROUTE OVER BROWNS FALLS DAM

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
60	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	-1

STAGE	1347.00	1348.00	1349.00	1350.00	1351.00	1352.00	1353.00	1355.00	1357.00
FLOW	0.00	630.00	1990.00	3900.00	6250.00	8910.00	11710.00	18030.00	25200.00
CAPACITY=	0.	143.	288.	437.	588.	744.	903.	1064.	1233.	1405.
	1580.	1761.	1946.	2137.						
ELEVATION=	1347.	1348.	1349.	1350.	1351.	1352.	1353.	1354.	1355.	1356.
	1357.	1358.	1359.	1360.						

CREL	SPWID	COGW	EXPW	ELEVL	COQL	CAREA	EXPL
1347.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COGD	EXPD	DAMWID
1352.0	2.6	1.5	680.

PEAK OUTFLOW IS 2710. AT TIME 53.00 HOURS

PEAK OUTFLOW IS 5446. AT TIME 53.00 HOURS

PEAK OUTFLOW IS 6810. AT TIME 53.00 HOURS

PEAK OUTFLOW IS 8172. AT TIME 53.00 HOURS

PEAK OUTFLOW IS 10956. AT TIME 52.00 HOURS

PEAK OUTFLOW IS 13703. AT TIME 52.00 HOURS

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HYDROGRAPH ROUTING

CHANNEL ROUTE THRU SLB AREA-7

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
70	1	0	0	0	0	1	C	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
C.0	0.000	C.CC	1	1	0	C	C

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.CCO	0.000	C.CCO	-1.	0

NORMAL DEPTH CHANNEL ROUTING

GN(1)	GN(2)	GN(3)	ELNVT	ELMAX	RLNTH	SEL
0.0800	0.0400	0.0800	11.0	19.C	12007.	0.C0CCC

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
100.00 1200.00 400.0C 1160.0C 55C.0C 1120.00 551.0C 1119.0C 559.00 1119.00
600.00 1120.00 700.0C 1140.0C 9CC.0C 1200.00

STORAGE	C.00	0.0C	0.0C	0.00	C.00	C.00	0.0C	0.00	C.CC
	0.00	0.0C	0.0C	0.00	C.00	C.00	C.CC	0.00	C.CO
OUTFLOW	C.00	0.CC	C.CC	0.00	C.00	0.00	C.CC	0.00	C.CC
	C.00	0.CC	0.CC	0.00	0.00	0.00	C.CC	0.00	C.CC
STAGE	11.00	11.42	11.84	12.26	12.68	13.11	13.53	13.95	14.37
	15.21	15.63	16.05	16.47	16.89	17.32	17.74	18.16	18.58
FLOW	0.00	0.CC	0.CC	0.00	C.00	C.00	C.CC	0.0C	C.CC
	C.00	0.CC	C.CC	0.00	C.00	C.00	C.CC	0.00	0.CC

MAXIMUM STAGE IS 11.C

MAXIMUM STAGE IS 11.0

MAXIMUM STAGE IS 11.0

MAXIMUM STAGE IS 11.C

MAXIMUM STAGE IS 11.0

MAXIMUM STAGE IS 11.0

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SUB-AREA RUNOFF COMPUTATION

SUB AREA-7 RUNOFF

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
7	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	0.72	0.00	183.90	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	18.50	76.00	90.00	102.00	106.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS 0.881

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.10	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 2.79 CP=0.77 NTA= 0

RECESSION DATA

STRTQ= 2.00 QRCSN= 2.00 RTIOR= 1.00

UNIT HYDROGRAPH 9 END-OF-PERIOD ORDINATES, LAG= 2.76 HOURS, CP= 0.76 VOL= 1.00

25. 81. 123. 113. 68. 30. 14. 6. 3.

C

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	17.27	14.14	3.13	6711.
										(439.)	(359.)	(80.)	(190.03)

********** ********** ********** ********** **********

COMBINE HYDROGRAPHS

COMBINE 2 HYDROGRAPHS AT 70

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
70	2	0	0	0	0	1	0	0

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS

FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 0.20	RATIO 2 0.40	RATIO 3 0.50	RATIO 4 0.60	RATIO 5 0.80	RATIO 6 1.00
HYDROGRAPH AT	1	41.70	1	4095.	8190.	10237.	12284.	16379.	20474.
		(108.00)	(	115.95)(	231.90)(	289.88)(	347.85)(	463.80)(	579.75)(
ROUTED TO	20	41.70	1	3895.	7848.	9816.	11727.	15571.	19447.
		(108.00)	(	110.30)(	222.23)(	277.96)(	332.07)(	440.92)(	550.67)(
HYDROGRAPH AT	2	32.90	1	2760.	5519.	6899.	8279.	11039.	13798.
		(85.21)	(	78.15)(	156.29)(	195.36)(	234.44)(	312.58)(	390.73)(
2 COMBINED	20	74.60	1	6655.	13367.	16715.	20006.	26610.	33245.
		(193.21)	(	188.45)(	378.52)(	473.32)(	566.50)(	753.50)(	941.39)(
ROUTED TO	30	74.60	1	4200.	9738.	12696.	15719.	21768.	27775.
		(193.21)	(	118.94)(	275.74)(	359.52)(	445.11)(	616.41)(	786.50)(
HYDROGRAPH AT	3	14.60	1	1824.	3648.	4560.	5472.	7296.	9121.
		(37.81)	(	51.65)(	103.31)(	129.13)(	154.96)(	206.61)(	258.27)(
2 COMBINED	30	89.20	1	4543.	10640.	13897.	17239.	23923.	30579.
		(231.03)	(	128.63)(	301.30)(	393.51)(	488.16)(	677.42)(	865.89)(
ROUTED TO	40	89.20	1	3155.	8169.	10936.	13888.	19989.	26257.
		(231.03)	(	89.34)(	231.32)(	309.66)(	393.27)(	566.02)(	743.52)(
HYDROGRAPH AT	4	63.70	1	5230.	10460.	13075.	15690.	20919.	26149.
		(164.98)	(	148.09)(	296.19)(	370.23)(	444.28)(	592.37)(	740.47)(
ROUTED TO	400	63.70	1	338.	676.	845.	1014.	1542.	2208.
		(164.98)	(	9.57)(	19.14)(	23.92)(	28.71)(	43.65)(	62.53)(
ROUTED TO	50	63.70	1	338.	676.	845.	1014.	1542.	2208.
		(164.98)	(	9.57)(	19.14)(	23.92)(	28.71)(	43.65)(	62.53)(
HYDROGRAPH AT	5	25.90	1	2491.	4982.	6227.	7473.	9964.	12455.
		(67.08)	(	70.54)(	141.07)(	176.34)(	211.61)(	282.15)(	352.68)(
2 COMBINED	50	89.60	1	2624.	5248.	6560.	7872.	10496.	13120.
		(232.06)	(	74.30)(	148.61)(	185.76)(	222.91)(	297.22)(	371.52)(
ROUTED TO	500	89.60	1	2624.	5248.	6560.	7872.	10496.	13120.
		(232.06)	(	74.30)(	148.61)(	185.76)(	222.91)(	297.22)(	371.52)(

ROUTED TO	60	89.60	1	2616.	5232.	6540.	7848.	10487.	13108.
		(232.06)		(74.07)(	148.15)(	185.19)(	222.23)(	296.95)(	371.19)(
HYDROGRAPH AT	6	5.10	1	1067.	2134.	2667.	3201.	4268.	5335.
		(13.21)		(30.21)(	60.43)(	75.53)(	90.64)(	120.86)(	151.07)(
2 COMBINED	60	94.70	1	2729.	5462.	6828.	8193.	10976.	13720.
		(245.27)		(77.28)(	154.68)(	193.34)(	232.01)(	310.81)(	388.51)(
ROUTED TO	60	94.70	1	2710.	5446.	6810.	8172.	10956.	13703.
		(245.27)		(76.75)(	154.20)(	192.85)(	231.39)(	310.24)(	388.03)(
ROUTED TO	70	94.70	1	2710.	5446.	6810.	8172.	10956.	13703.
		(245.27)		(76.75)(	154.20)(	192.85)(	231.39)(	310.24)(	388.03)(
HYDROGRAPH AT	7	0.72	1	213.	426.	533.	639.	852.	1065.
		(1.86)		(6.03)(	12.07)(	15.08)(	18.10)(	24.13)(	30.17)(
2 COMBINED	70	95.42	1	2712.	5448.	6814.	8176.	10967.	13717.
		(247.13)		(76.79)(	154.26)(	192.95)(	231.51)(	310.55)(	388.41)(

PLAN 1 STATION 20

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.20	3895.	1575.8	54.00
0.40	7848.	1578.8	54.00
0.50	9816.	1579.9	54.00
0.60	11727.	1580.9	54.00
0.80	15571.	1582.7	54.00
1.00	19447.	1584.2	54.00

PLAN 1 STATION 30

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.20	4200.	1478.0	62.00
0.40	9738.	1483.1	60.00
0.50	12696.	1485.2	60.00
0.60	15719.	1487.1	59.00
0.80	21768.	1490.5	59.00
1.00	27775.	1493.5	59.00

PLAN 1 STATION 40

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.20	3155.	1465.6	71.00

0.40	8169.	1470.1	67.00
0.50	10936.	1472.0	66.00
0.60	13888.	1473.8	65.00
0.80	19989.	1477.2	64.00
1.00	26257.	1480.3	63.00

PLAN 1 STATION 400

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.20	338.	1491.0	85.00
0.40	676.	1491.5	85.00
0.50	845.	1491.8	85.00
0.60	1014.	1492.0	85.00
0.80	1542.	1492.7	83.00
1.00	2208.	1493.4	82.00

PLAN 1 STATION 50

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.20	338.	1430.0	85.00
0.40	676.	1430.0	85.00
0.50	845.	1430.0	85.00
0.60	1014.	1430.0	85.00
0.80	1542.	1430.0	83.00
1.00	2208.	1430.0	82.00

PLAN 1 STATION 500

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.20	2624.	1425.6	53.00
0.40	5248.	1426.6	53.00
0.50	6560.	1427.0	53.00
0.60	7872.	1427.3	53.00
0.80	10496.	1427.9	53.00
1.00	13120.	1428.5	53.00

PLAN 1 STATION 60

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.20	2616.	1328.2	53.00
0.40	5232.	1329.7	53.00
0.50	6540.	1330.4	53.00
0.60	7848.	1331.1	53.00
0.80	10487.	1332.3	53.00
1.00	13108.	1333.1	53.00

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1347.00	1347.00	1352.00
STORAGE	0.	0.	744.
OUTFLOW	0.	0.	8910.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.20	1349.38	0.00	344.	2710.	0.00	53.00	0.00
0.40	1350.66	0.00	536.	5446.	0.00	53.00	0.00
0.50	1351.21	0.00	621.	6810.	0.00	53.00	0.00
0.60	1351.72	0.00	701.	8172.	0.00	53.00	0.00
0.80	1352.50	0.50	824.	10956.	13.00	52.00	0.00
1.00	1353.03	1.03	908.	13703.	17.00	52.00	0.00

PLAN 1 STATION 70

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.20	2710.	11.0	53.00
0.40	5446.	11.0	53.00
0.50	6810.	11.0	53.00
0.60	8172.	11.0	53.00
0.80	10956.	11.0	52.00
1.00	13703.	11.0	52.00

A1 BROWNS FALLS DAM

PAGE 0001

AAUE

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(0001)   A1       BROWNS FALLS DAM
(0002)   A2       HEC-1DB
(0003)   A3       PRE-OVERTOPPING ANALSIS (SNYDERS)
(0004)   B     90          1         0         0         0         0         0         4
(0005)   G1     5
(0006)   J      1          0         1
(0007)   J1    .4         .4        .5        .6        .8       1.0
(0008)   K      0          1         0         0         0         0         1
(0009)   K1        SUB AREA-1 RUNOFF
(0010)   B      1          1      41.7         0     183.9         0         0         0         1
(0011)   P      0       18.5        78        90       102       106
(0012)   T      0          0         0         0         0         0         1       0.1
(0013)   R  15.57        .77
(0014)   X     64         64         1
(0015)   K      1         20         0         0         0         0         1
(0016)   K1        CHANNEL ROUTE THRU SUB AREA-2
(0017)   Y      0          0         0         1         1
(0018)   Y1     1          0         0         0         0         0        -1
(0019)   Y6   .08        .04       .06      1569      1600     45400      .002
(0020)   Y7   100        160       110       158       122      1571       123      1569      1300      1569
(0021)   Y7  1578       1571      1400       158       178      1600
(0022)   K      0          2         0         0         0         0         1
(0023)   K1        SUB AREA-2
(0024)   B      1          1      32.9         0     183.9         0         0         0         1
(0025)   P      0       18.5        78        90       102       106
(0026)   T      0          0         0         0         0         0         1       0.1
(0027)   R  16.20        .77
(0028)   X     66         66         1
(0029)   K      2         20         0         0         0         0         1
(0030)   K1        COMBINE 2 HYDROGRAPHS AT 20
(0031)   K      1         30         0         0         0         0         1
(0032)   K1        CHANNEL ROUTE THRU SUB AREA-3
(0033)   Y      0          0         0         1         1
(0034)   Y1     1          0         0         0         0         0        -1
(0035)   Y6   .08        .04       .06      1470      1520     23600    .00001
(0036)   Y7   100        152       200      1500       400      1485       500      1470      1600      1470
(0037)   Y7  1750       1485      2000      1500      2100      1520
(0038)   K      0          3         0         0         0         0         1
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(0039)  K1      SUB AREA-3 RUNOFF
(0040)  K       1       1     14.6        0    183.9        0        0        0        1
(0041)  T       0    18.5       76       90      102      106
(0042)  T       0       0        0        0        0        0        1      0.1
(0043)  S   10.09     .77
(0044)  X      30       30       1
(0045)  K       2       30       0        0        0        0        1
(0046)  K1      COMBINE 2 HYDROGRAPHS AT 30
(0047)  K       1       40       0        0        0        0        1
(0048)  K1      CHANNEL ROUTE THRU SUB AREA-4
(0049)  Y       0        0       0        1        1
(0050)  Y1      1        0       0        0        0        0       -1
(0051)  YA    .03      .04     .05     1460     1520    24600    .00001
(0052)  Y7    100     1500     400     1500      700     1485      750     1460     2200     1460
(0053)  Y7   2350     1485    2400     1500     2700     1520
(0054)  K       0        4       0        0        0        0        1
(0055)  K1      SUB AREA-4 RUNOFF
(0056)  K       1        1    65.7        0    183.9        0        0        0        1
(0057)  T       0    18.5       76       90      102      106
(0058)  T       0       0        0        0        0        0        1      0.1
(0059)  S   12.76     .77
(0060)  X     120      120       1
(0061)  K       1       40       0        0        0        0        1
(0062)  K1      ROUTE OVER CRABTREE LAKE DAM
(0063)  Y       0        0       0        1        1
(0064)  Y1      1        0       0        0        0        0       -1
(0065)  Y4   1490     1491     1492     1493     1494     1495     1496     1497     1498     1499
(0066)  Y5      0      352      995     1829     2816     3936     5173     6519     7965     9504
(0067)  K       1       50       0        0        0        0        1
(0068)  K1      CHANNEL ROUTE THRU SUB AREA-5
(0069)  Y       0        0       0        1        1
(0070)  Y1      1        0       0        0        0        0       -1
(0071)  YA    .03      .04     .05     1430     1460    45600    .0004
(0072)  Y7    100     1460     400     1440      590     1435      600     1430      740     1430
(0073)  Y7    750     1435     200     1440     2300     1460
(0074)  K       0        5       0        0        0        0        1
(0075)  K1      SUB AREA-5 RUNOFF
(0076)  K       1        1    25.9        0    183.9        0        0        0        1
```

STATION 04261000 OSWEGATCHIE RIVER AT CRANBERRY LAKE, N.Y.

TOTAL D.A. = 144.00 CONTR. D.A. =
GAGE DATUM = 1458.23 FT.

WATER YEAR	ANNUAL PEAK DISCH.CFS	DATE	CODES	HIGHEST SINCE	GAGE HEIGHT OF ANNUAL PEAK.FT	CODE	ANNUAL MAX GAGE HT.FT	DATE	CODE
1923	1010	06-11-23	MD KR		6.6				
1924	1590	05-18-24	MD KR		7.5				
1925	990	04-23-25	MD KR		6.7				
1926	1170	05-07-26	MD KR						
1927	680	03-28-27	MD KR						
1928	1100	04-11-28	MD KR						
1929	1340	05-06-29	MD KR						
1930	1320	04-15-30	MD KR						
1931	270	10-01-30	MD KR						
1932	1390	04-13-32	MD KR						
1933	1620	04-18-33	MD KR						
1934	325	05-02-34	MD KR						
1935	930	06-22-35	MD KR						
1936	800	04-12-36	MD KR		6.3				
1937	1200	01-19-37	MD KR		7.0				
1938	1080	04-02-38	MD KR		6.8				
1939	499	12-16-38	KR		5.49				
1940	742	05-07-40	KR		6.05				
1941	365	03-07-41	KR		5.18				
1942	1290	04-20-42	KR		7.05				
1943	1940	05-13-43	KR		7.70				
1944	995	05-09-44	KR		6.47				
1945	1020	04-04-45	KR		6.49				
1946	657	11-04-45	KR		5.83				
1947	1850	05-07-47	KR		7.59				
1948	1340	05-16-48	KR		6.94				
1949	681	04-27-49	KR		5.88				
1950	828	04-25-50	KR		6.16				
1951	1430	04-15-51	KR		7.05				
1952	856	05-26-52	KR		6.21				
1953	1170	04-04-53	KR		6.71				
1954	1490	04-19-54	KR		7.13				
1955	1300	04-21-55	KR		6.88				
1956	891	06-02-56	KR		6.27				
1957	962	09-18-57	KR		6.39				
1958	730	10-01-57	KR		5.98				
1959	1130	04-22-59	KR		6.66				
1960	942	04-27-60	KR		6.37				
1961	625	05-09-61	KR		5.83				
1962	742 754	04-30-62 (50)(62)	KR		6.07				
1963	737 742	05-14-63	KR		6.05				
1964	910	04-22-64	KR		6.33				
1965	372	04-29-65	MD KR						
1966	484	12-07-65	MD KR						
1967	744	05-21-67	MD KR						
1968	654	04-06-68	MD KR						
1969	870	05-22-69	MD KR						
1970	741	05-01-70	MD KR						
1971	1490	05-14-71	MD KR						
1972	852	05-09-72	MD KR						
1973	994	05-24-73	MD KR						
1974	934	05-07-74	MD KR						

STATION 04261000 OSWEGATCHIE RIVER AT CRANBERRY LAKE, N.Y.

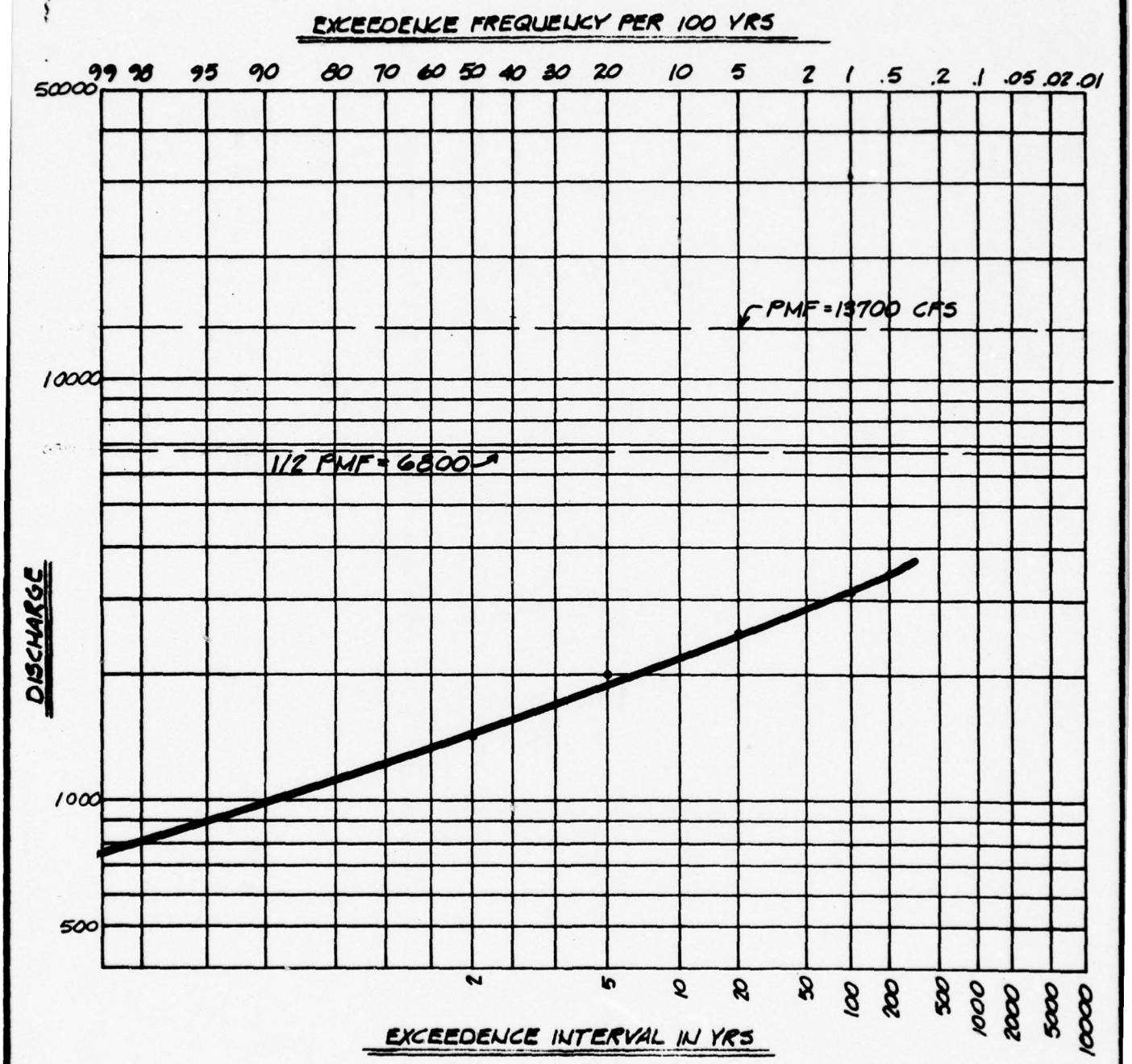
TOTAL D.A. = 144.00 CONTR. D.A. =
GAGE DATUM = 1458.23 FT.

WATER YEAR	ANNUAL PEAK DISCH,CFS	DATE	CODES	HIGHEST SINCE	GAGE HEIGHT OF ANNUAL PEAK,FT	CODE	ANNUAL MAX GAGE HT,FT	DATE	CODE
1975	852	05-04-75	MD KR						

STATION 04261500 OSWEGATCHIE RIVER AT NEWTON FALLS, N.Y.

TOTAL D.A. = 171.00 CONTR. D.A. =
GAGE DATUM = 1370.00 FT.

WATER YEAR	ANNUAL PEAK DISCH.CFS	DATE	CODES	HIGHEST SINCE	GAGE HEIGHT OF ANNUAL PEAK,FT	CODE	ANNUAL MAX GAGE HT.FT	DATE	CODE
1913	2100	03-28-13	KR						
1914	1150	04-20-14	KR						
1915	910 ~~480~~	04-12-15	KR						
1916	1930	05-18-16	KR						
1917	938	06-12-17	KR						
1918	1440	05-15-18	KR						
1919	1680	04-13-19	KR						
1920	1800	04-30-20	KR						
1921	2000	03-24-21	KR		6.8				
1922	2000	04-18-22	KR		6.8				



BROWN'S FALLS DAM

DISCHARGE - FREQUENCY CURVE

STETSON • DALE BANKERS TRUST BUILDING UTICA • NEW YORK • 13501
TEL 315-797-5800

DESIGN BRIEF

PROJECT NAME _____ DATE 8-27-79

SUBJECT Browns Falls PROJECT NO. _____

DRAWN BY JAG

Discharge - from ogee crest spillway until pool reaches elev. 1352, then there will also be flow over the dam.

Ogee Crest - uncontrolled overflow

Length, L ~ 192'

Crest Elev. = 1347.0

H.W. Elev. ~ 1350.6 ∴ Assume $H_d = 3.6'$

Top of Dam Elev. = 1352.0

Spillway Height, h ~ 60'

Reference: Open-Channel Hydraulics - Chow

$C_d = 4.03$ $h/H_d = \frac{60}{3.6} = 16.7$

Elev.	H_e	H_e/H_d	C/C_d	C	$Q = C L H_e^{3/2}$
1347.0	0	—	—	—	0
1348.0	1.0	0.28	0.82	3.30	630 cfs
1349.0	2.	0.56	.91	3.67	1,990
1350.0	3.	0.83	.97	3.91	3,900
1351.0	4.	1.11	1.01	4.07	6,250
1352.0	5.	1.39	1.03	4.15	8,910
1353.	6.	1.67	1.03	4.15	11,710
1355.	8.	2.22	1.03	4.15	18,030
1357.	10.	2.78	1.03	4.15	25,200
1359.	12.	3.33	1.03	4.15	33,120
1361.	14.	3.89	1.03	4.15	41,740
1363.	16.	4.44	1.03	4.15	51,000

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DESIGN BRIEF

PROJECT NAME _____ DATE _____

SUBJECT Browns Falls PROJECT NO. _____

DRAWN BY _____

Discharge over Dam - from flow over sluice block, intake block and non-overflow sections (sections 4-4, 5-5, & 1-1, respectively).

sluice block + intake block sections -
crest width = 17' - 20'
Length, L ~ 28' + 62' = 90'
Reference: Handbook of Hydraulics - King & Brater

Elev.	H_e	C	$Q = C L H_e^{3/2}$
1352.	0	2.63	-
1353.	1.'	2.63	240 cfs
1355.	3.	2.63	1230
1357.	5.	2.63	2650
1359.	7.	2.63	4380
1361.	9.	2.63	6390
1363.	11.	2.63	8640

Section 1-1 (non-overflow section)
crest width = 8'
Length = 130' + 383' + 76' = 589'

Elev.	H_e	C	$Q = C L H_e^{3/2}$
1352.	0	-	-
1353.	1'	2.68	1,580 cfs
1355.	3	2.65	8,110
1357.	5	2.70	17,780
1359.	7	2.7	29,450
1361.	9	2.7	42,940
1363.	11	2.7	58,020

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DESIGN BRIEF

PROJECT NAME _____ DATE _____

SUBJECT Browns Falls PROJECT NO. _____

DRAWN BY _____

Combined Discharge

Elev.	H_e (ft)	Q (cfs)
1347.	0	—
1348.	1	630
1349.	2	1,990
1350.	3	3,900
1351.	4	6,250
1352.	5	8,910
1353.	6	13,530
1355.	8	27,370
1357.	10	45,630
1359.	12	67,040
1361.	14	91,070
1363.	16	117,660

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PROJECT NAME Browns Falls DATE

SUBJECT PROJECT NO.

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Tailwater Curve

Control section estimated as 350' downstream of dam.

water depth	Area, A	Hydraulic Radius, R	Q, cfs
1'	4.25 ft²	8.73	134
2	17.	17.46	852
3	38.3	26.19	2,516
4	68	35.	5,420
5	106	43.7	9,800
6	153	52.4	15,960
8	272	69.8	34,350
10	425	87.3	62,300
12	612	105	101,300
14	833	122	153,000

Based on Mannings eqn. $Q = AR^{2/3}S^{1/2}\frac{1.49}{n}$
with estimates of $S = .04$, $n = .04$

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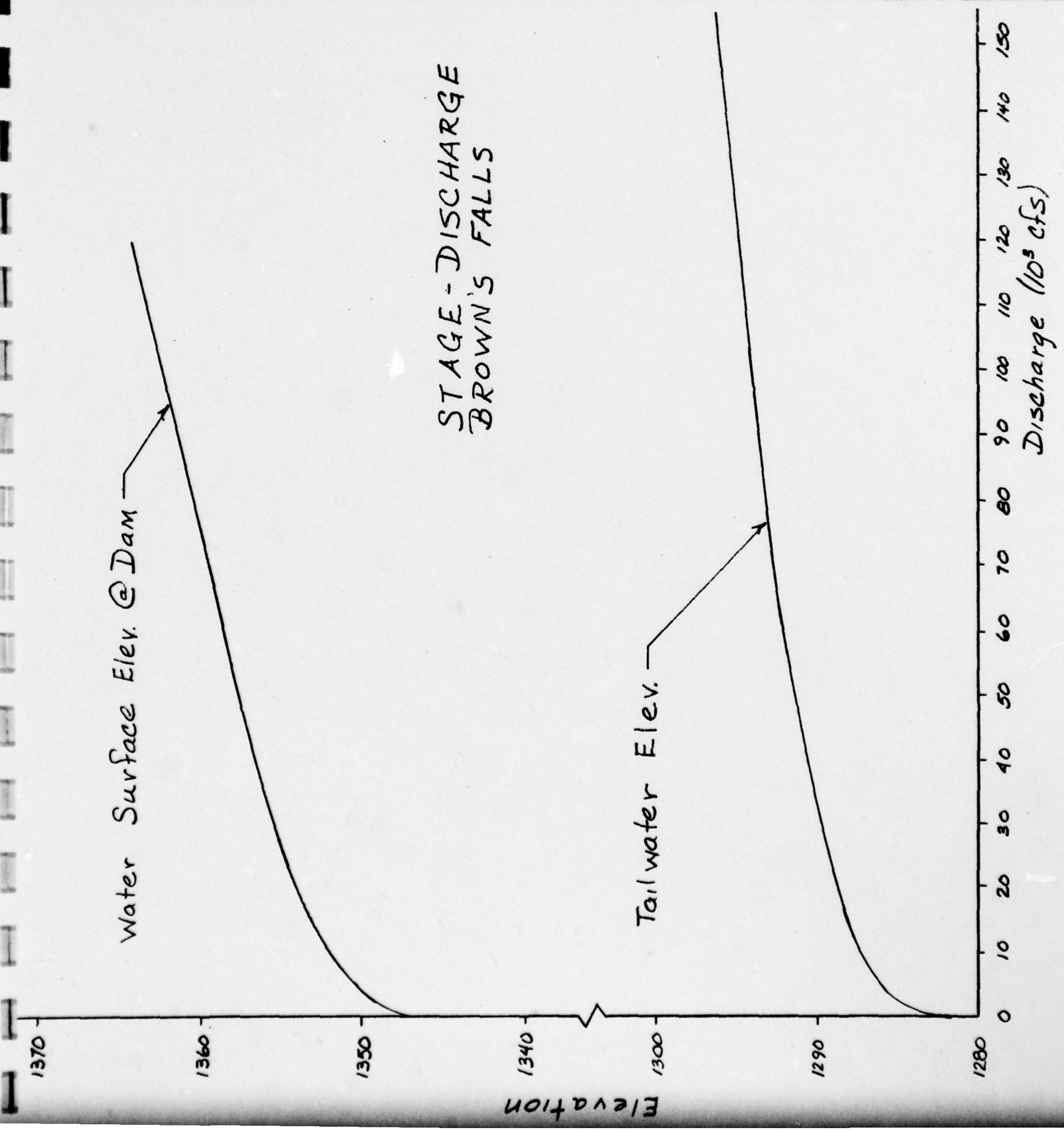

APPENDIX D

STABILITY ANALYSIS

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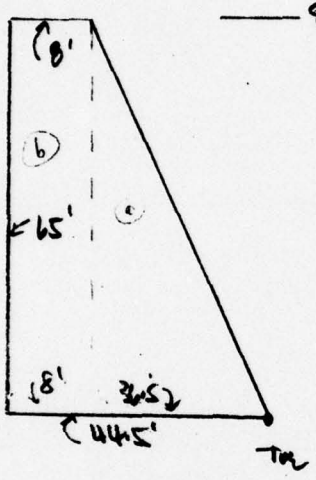
PROJECT NAME BROWNS FALLS DAM DATE

SUBJECT STABILITY ANALYSIS - OVERTURNING & SLIDING PROJECT NO.

DRAWN BY

Section Assumed For Analysis As Shown



Spillway Section
Section 3-3

M_{toe} due to mass of dam =

$= \left(\frac{1}{2} \times 36.5 \times 65 \times .15\right)\left(\frac{2}{3} \times 36.5\right) + \left(8 \times 65 \times .15\right)\left(\frac{8}{2} + 36.5\right)$

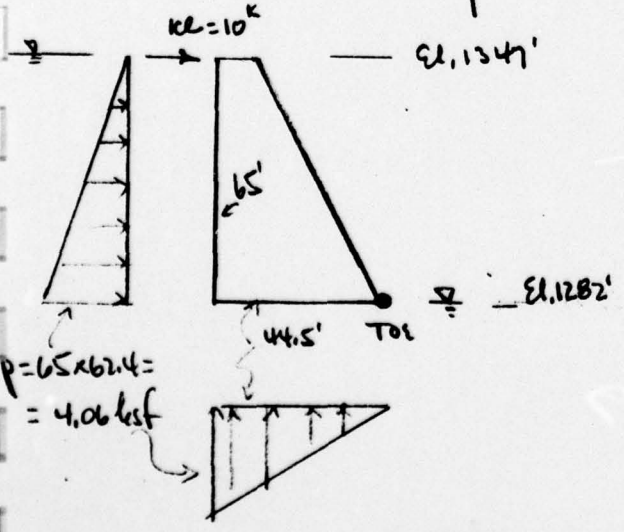
$= 4330^{k} + 3159^{k} = \underline{7489^{k}}$

Wt. of dam $= \left(\frac{1}{2} \times 36.5 \times 65 \times .15\right) +$

$+ \left(8 \times 65 \times .15\right) =$

$= 178^{k} + 78^{k} = \underline{256^{k}}$

(I) WL @ normal operating level



M_{toe} causing overturning = upst. H_2O + uplift + ice

$= \left(\frac{1}{2} \times 4.06 \times 65\right)\left(\frac{65}{3}\right) + \left(\frac{1}{2} \times 4.06 \times 44.5\right)\left(\frac{1}{3} \times 44.5\right) +$

$+ \left(10^{k} \times 64'\right) =$

$= 2859^{k} + 2680^{k} + 640^{k} = 6179^{k}$

FS against overturning $= \frac{7489}{6179} = \underline{1.21}$

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(7)

Position of resultant measured from toe, $d = \frac{\Sigma M_{toe}}{\Sigma V}$

$$d = \frac{(7489 - 6179)^{ik}}{256 - (\frac{1}{2} \times 4.06 \times 44.5)} = \frac{1310^{ik}}{165.7^{k}} = 8' \pm$$

(90.3)

d in terms of base width b: $d = \frac{8'}{44.5'}(b) = 0.18(b)$

FS against sliding (friction-shear method, using 50 psi bond strength and $\mu = 0.65$)

$$FS = \frac{(0.65)(256 - 90.3) + (.05 \times 144 \times 44.5)}{(\frac{1}{2} \times 4.06 \times 65) + (10^{k})} = \frac{428}{142} = 3 \pm$$

(100) (320) (132)

note 50 psi bond-shear is very conservative; for 100 psi (up to 200 ok)

$$FS = \frac{108 + 640}{142} = 5 \pm$$

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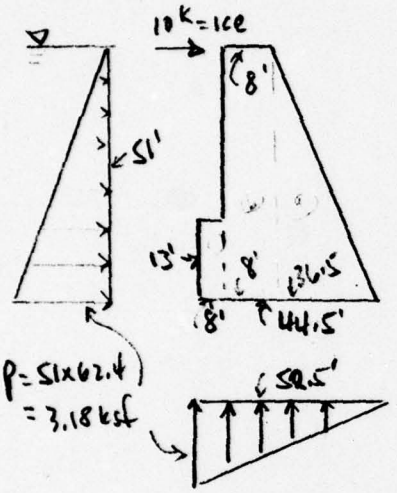
Non Spillway, Sta 1+50, right end

Check Section 2-2 WL @ normal operating levels



M_{toe} due to mass of dam =

$= \left(\frac{1}{2} \times 51 \times 36.5 \times .15\right)\left(\frac{2}{3} \times 36.5\right) + \left(8 \times 51 \times .15\right)\left(40.5\right)$

$+ \left(13 \times 8 \times .15\right)\left(44.5 + \frac{8}{2}\right) =$

$= 3397^{k} + 2479^{k} + 611^{k} = 6487^{k}$

Wt. dam = $140 + 61 + 15 = 216^{k}$

M_{toe} causing overturning $= \left(\frac{1}{2} \times 3.18 \times 51 \times \frac{51}{3}\right) + \left(\frac{1}{2} \times 3.18 \times 52.5\right)\left(\frac{2}{3} \times 58.5\right) +$

$+ \left(10^{k} \times 50'\right) = 1579^{k} + 2921^{k} + 500^{k} = 4801^{k}$

FS against overturning $= \frac{6487^{k}}{4801^{k}} = 1.35 \pm$

Position of resultant measured from toe

$$d = \frac{\Sigma M_{toe}}{\Sigma V} = \frac{(6487 - 4801)^{k}}{216 - \left(\frac{1}{2} \times 3.18 \times 52.5\right)} = \frac{1686^{k}}{132.5^{k}} = 12.7' \pm$$

d in terms of base width, b

$$d = \frac{12.7}{52.5}(b) = 0.24(b) \quad \text{(still outside } b/3\text{)}$$

$$d = \frac{12.7}{40.5}(b) = 0.28(b)$$

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FS against sliding (friction-shear method, use 100 psi bond, $\mu = 0.65$)

$$FS = \frac{(0.65 \times 132.5) + (.10 \times 144 \times 52.5)}{(\frac{1}{2})(3.18 \times 51)} = \frac{842^{k}}{81^{k}} = \underline{10+}$$

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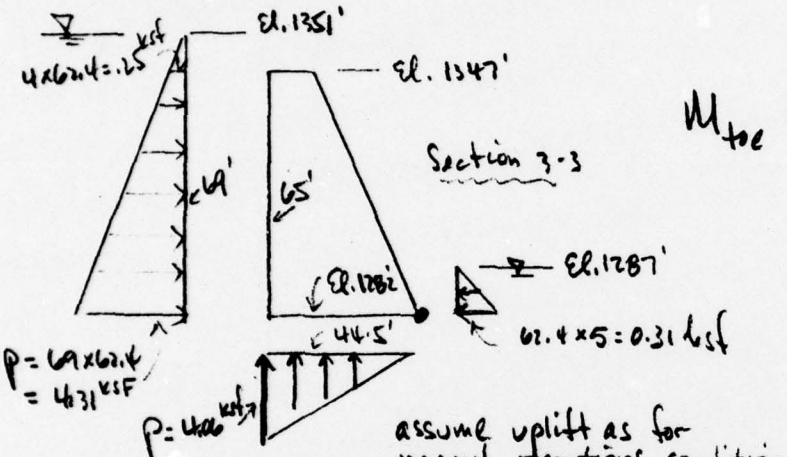
(II) WL @ ½ PMF elevations — upstream elev. 1351' (4' above dam)
downstream elev 1287'



M_{toe} resisting overturning = mass dam + dnst. H_2O

$= 7489^{k} + \left(\frac{1}{2} \times 0.31 \times 5 \times \frac{5}{3}\right) = 7490^{k}$

M_{toe} causing overturning = upst. H_2O + uplift

$= \left(0.25 \times 65 \times \frac{65}{2}\right) + \left(4.06 \times \frac{65}{2} \times \frac{65}{3}\right) + 2680^{k} = 6067^{k}$

FS against overturning = $\frac{7490^{k}}{6067^{k}} = \underline{1.23 \pm}$

Position of resultant measured from toe, $d = \frac{(7490-6067)^{k}}{165.7^{k}} = 8.6'$

d in terms of base width b $\therefore d = \frac{8.6}{44.5} = \underline{0.19\,(b)}$

FS against Sliding (friction-shear method, using 100 psi bond and $\mu = 0.65$)

$= \dfrac{(0.65)(256-90.3) + (.10 \times 144 \times 44.5) + (\frac{1}{2} \times .35 \times 5)}{(\frac{1}{2})(.25+4.31)(65)} = \dfrac{549^{k}}{148^{k}} = \underline{3.7}$

FS would be greater than 4 if shear/bond of 100 psi can [illegible]

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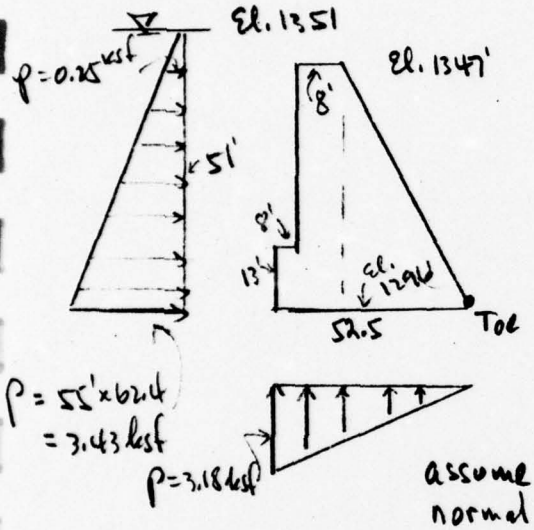
Check Section 2-2



M_{tot} resisting overturning = 6487 ft-k

assume uplift as for normal operations condition

M_{tot} causing overturning = $\left(0.25 \times 51 \times \frac{51}{2}\right)$ (uplift H₂O) $+ \left(\frac{1}{2}\right)\left(3.18 \times 51 \times \frac{51}{3}\right)$ (uplift) $+ 2921$ ft-k =

$= 325$ ft-k $+ 1379$ ft-k $+ 2921$ ft-k $= 4625$ ft-k

FS against overturning = $\frac{6487 \text{ ft-k}}{4625 \text{ ft-k}} = 1.40 \pm$

Position of resultant measured from toe, $d = \frac{(6487 - 4625)^{1862} \text{ ft-k}}{132.5} = 14' \pm$

d in terms of base width b : $d = \frac{14}{52.5}(b) = 0.27(b)$

$d = \frac{14}{44.5}(b) = 0.31(b)$

FS against sliding = $\frac{(0.105)(132.5) + (.10 \times 144 \times 52.5)}{\frac{1}{2}(0.25 + 3.43)(51)} = \frac{86 + 756}{94} = 9 \pm$

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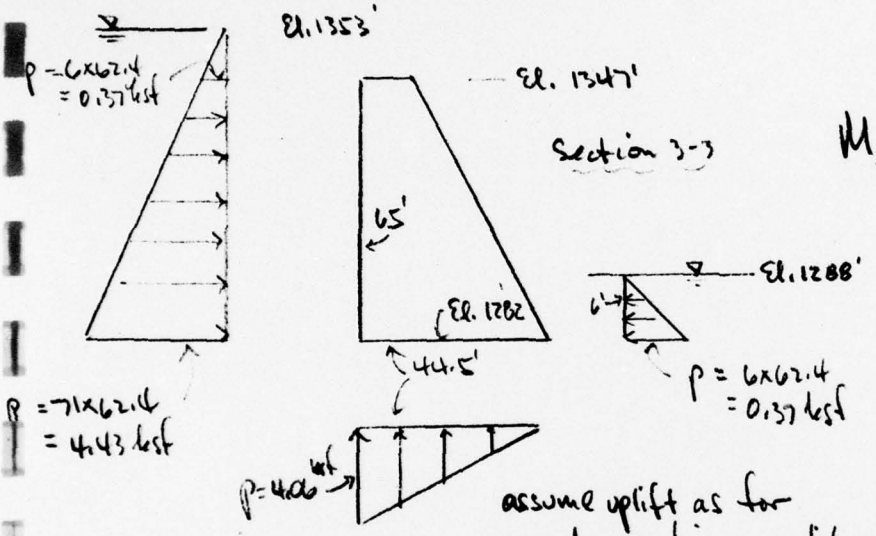
(III) WL @ PMF elevations

upstream elev 1353' (6' above dam)
dnst. elev 1288'



assume uplift as for normal operations condition

M_{toe} resisting overturning = mass dam + uplift

$= 7489^{k} + \left(\frac{1}{2} \times .37 \times 6 \times \frac{6}{3}\right) = 7491^{k}$

M_{toe} causing overturning $= \left(0.37 \times 65 \times \frac{65}{2}\right)_{uplift \cdot H_2O} + \left(4.06 \times \frac{65}{2} \times \frac{65}{3}\right) + 2680_{uplift} = 6320^{k}$

FS against overturning $= \frac{7491^{k}}{6320^{k}} = \underline{1.19 \pm}$

Position of resultant measured from toe: $d = \frac{\Sigma M_{toe}}{\Sigma V}$

$d = \frac{(7491 - 6320)^{k}}{165.7^{k}} = \underline{7.07'}$

d in terms of base width b: $d = \frac{7.07}{44.5}(b) = \underline{0.16(b)}$

FS against sliding: $\frac{108 + 640 + (\frac{1}{2} \times .37 \times 6)}{(\frac{1}{2})(0.37 + 4.43)(65')} = \frac{749}{156} = \underline{4.8 \pm}$

Say $\underline{5 \pm}$

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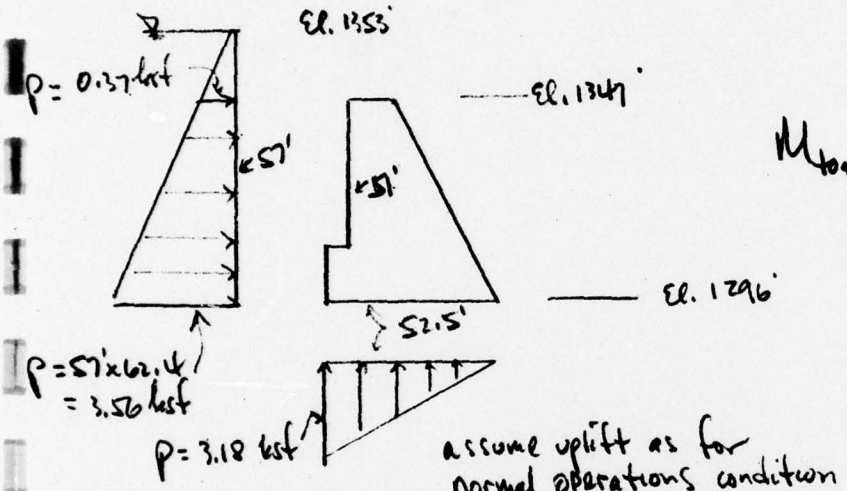
check section 2-2



M_{toe} resisting overturning = 6487 ^k

M_{toe} causing overturning = $(0.37 \times 51 \times \frac{51}{2}) + (\frac{1}{2})(3.18 \times 51 \times \frac{51}{3}) + 2921 =$ (wt. H₂O, wt. of)

$= 481^{k} + 1379^{k} + 2921^{k} = 4781^{k}$

FS against overturning = $\frac{6487^{k}}{4781^{k}} = \underline{1.36}$ ±

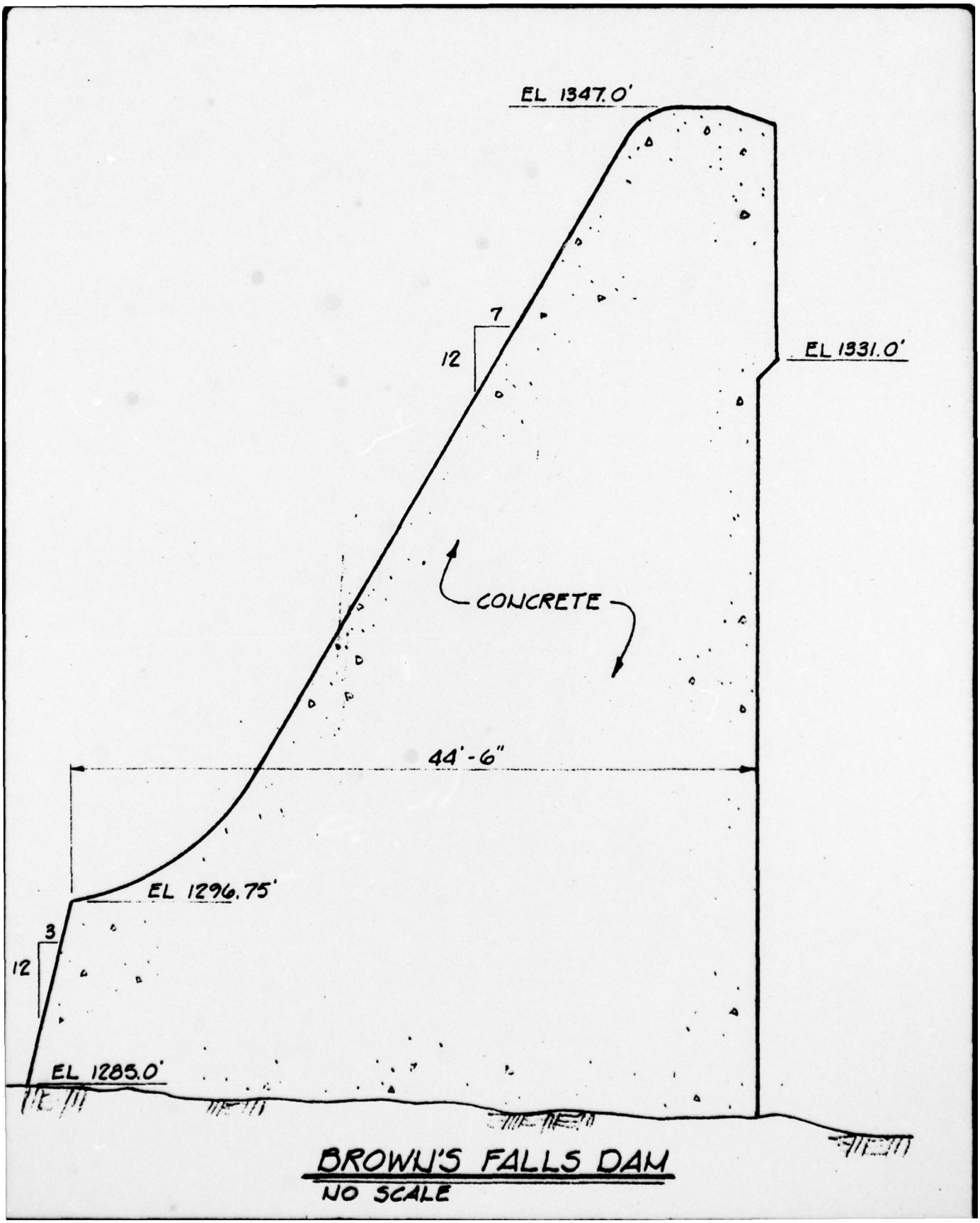
Position of resultant measured from toe, $d = \frac{\Sigma M_{toe}}{\Sigma V}$ (1706)

$d = \frac{(6487 - 4781)^{k}}{132.5} = \underline{12.9'}$

d in terms of base width b : $d = \frac{12.9}{52.5}(b) = 0.25(b)$

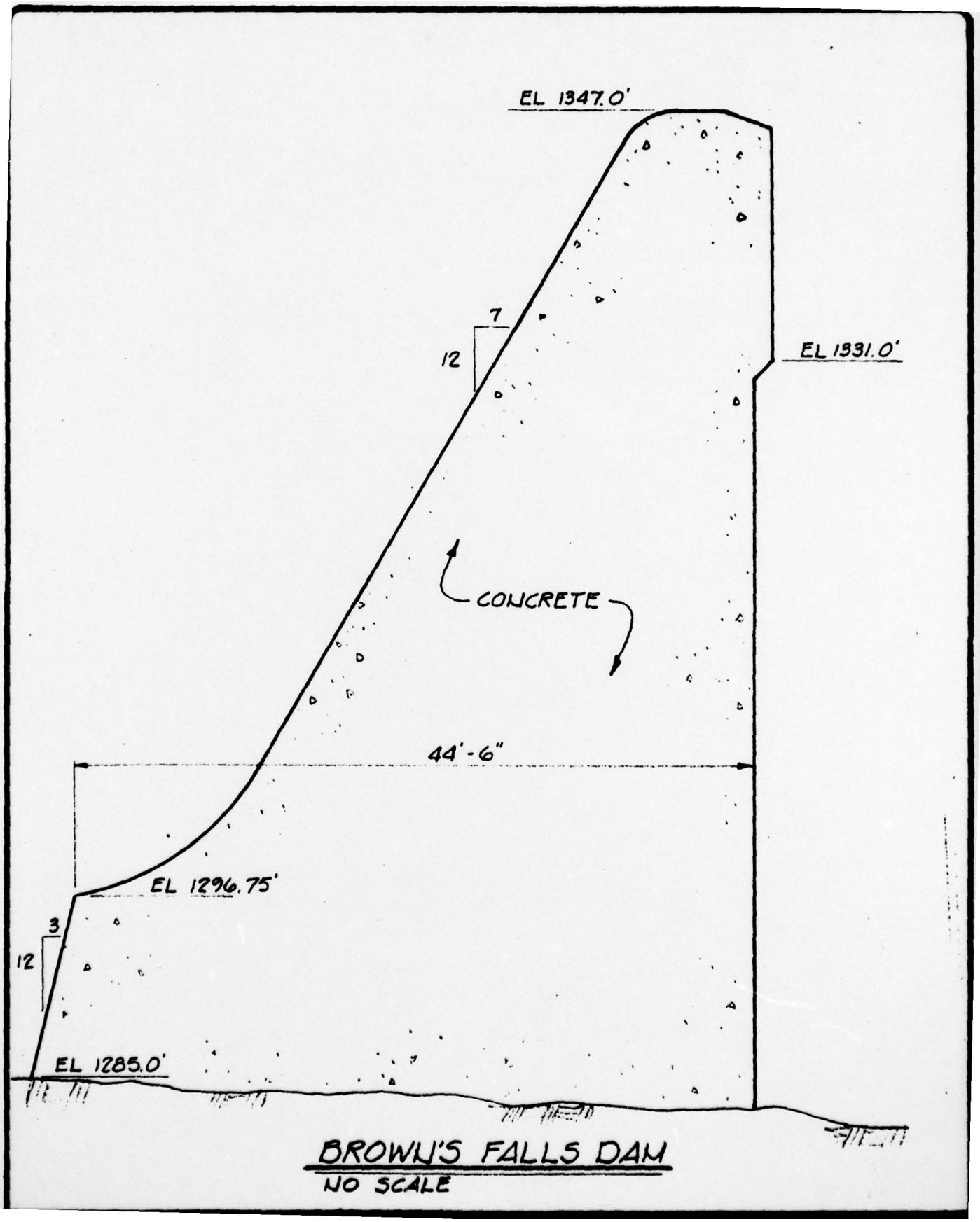
$d = \frac{12.9}{44.5}(b) = 0.29(b)$

FS against sliding = $\frac{86 + 756}{(\frac{1}{2})(.37 + 3.56)(51)} = \frac{842}{100.2} = \underline{8.4}$ ±



BROWN'S FALLS DAM

NO SCALE



BROWN'S FALLS DAM

NO SCALE

APPENDIX E

REFERENCES

APPENDIX

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